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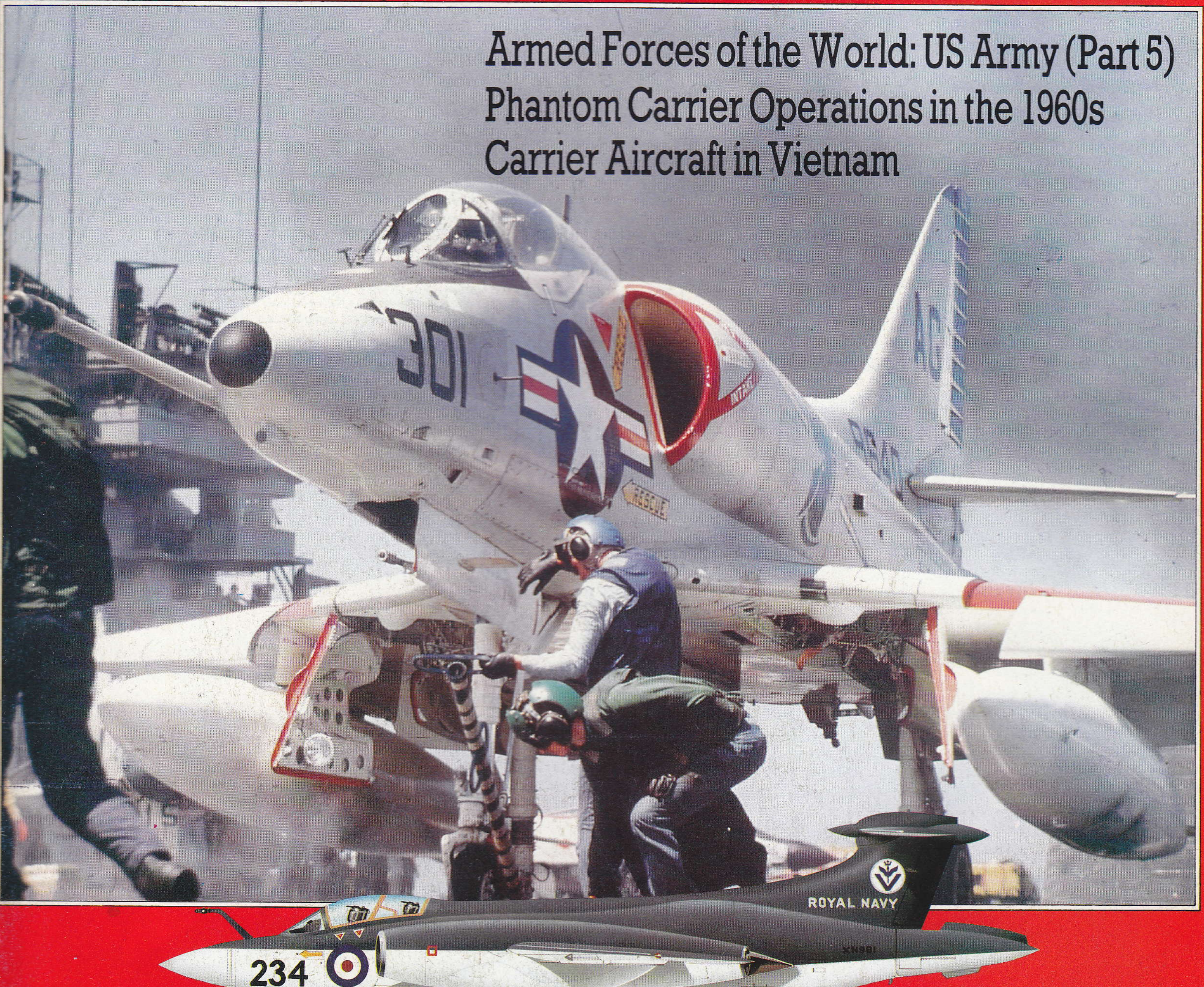
Phantom Carrier Operations in the 1960s

Carrier Aircraft in Vietnam



A fully illustrated guide to Carrier Aircraft of the 1960s

WAR MACHINE

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Editorial Offices
War Machine
Aerospace Publishing Ltd
10 Barley Mow Passage
London W4 4PH

Managing Editor: Stan Morse

Editorial:
Trisha Palmer
Chris Bishop
Chris Chant
Ian Drury

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Artists:
Keith Fretwell
Keith Woodcock

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Subscription Manager: Christine Allen
0488 72666

Consultant Editor: Major General Sir Jeremy Moore KCB OBE MC, Commander of British Land Forces during the Falklands campaign.

Distribution and marketing offices:
Orbis Publishing Ltd
Orbis House
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Telephone: 01-379 6711

Circulation Director: David Breed

Marketing Director: Michael Joyce

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Carrier Aircraft of the 1960s

Carrier aircraft continued to develop throughout the 1960s, and the new generation of aircraft were more capable than ever. Leading the way were the Americans, who had the chance of proving their carrierborne air power over the skies of South East Asia. Here we describe the shipboard aircraft of the era and their combat action.

With a narrow-track undercarriage and its large size, the Douglas A-3 Skywarrior was quite a handful to land on a pitching deck. It was – and still is – one of the largest aircraft to fly from a carrier.

Well before the 1950s came to an end, the decade's hectic pace of aircraft technical development had resulted in several major transformations in shipboard aircraft. One was the emergence of the helicopter as a mature and useful weapon and transport vehicle, but that is not covered here. Another was the mating of the supersonic jet with the carrier deck, a synthesis that was assisted by growth in the size of those decks, but which was later accomplished by the British and French using decks no larger than those of World War II. The gas turbine engine played a central role in many of the new developments, one obvious advantage being elimination from the scene of high-octane petrol (gasoline). Its power transformed the capabilities of shipboard attack aircraft and two of the bombers discussed in this issue could take off at a weight exceeding 40 tons. Another new development, which in fact was first achieved with piston engines, was the combination in one aircraft of the ability to search for submerged submarines and then to attack them; previously this had demanded a team of two aircraft, one the hunter and the other the killer.

It is well known that carrier-based aircraft have a harsher life than those based on airfields, and that their design has to be more complex (for example they invariably have to fold up to fit in small hangars below decks). What may be less obvious is just how tough the design requirements really are. The pull of the modern catapult is nothing short of brutal; even if the aircraft had its engine off and the wheel brakes locked, the 'cat' would fling the aircraft off the deck at some 150 mph (241 km/h). Each 1-ton store hung under the aircraft slams back with the force of 5 tons, and even the fuel in the tanks exerts a 2-ton force on every square foot of tank rear wall! As for the landing, this is roughly like dropping from the roof of a two-storey building, often over a deck that is rolling or pitching in a rough sea. At the instant of impact the pilot slams the throttle(s) wide open in case the arresting cables are missed. The hook then snatches a cable and the colossal pull brings the screaming mass to a stop in just two seconds. Modern birds are designed to suffer this 6,000 times, and to stay serviceable.

Two of the most advanced carrier aircraft of the 1960s were the McDonnell F-4 Phantom II and the North American A-5 Vigilante, here seen together over Hawaii. The F-4 sometimes provided fighter escort for the A-5.

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USA

Douglas F-6 (F4D) Skyray

Douglas F4Ds of Marine squadron VMF-531 formate for the camera showing the distinctive lines of this aircraft. Bestowed with astonishing vertical climb, the Skyray served with the Marines until 1964, in both interceptor and ground-attack roles.

Yet another of Ed Heinemann's designs for the US Navy, the prototype **Douglas XF4D-1 Skyray** flew on 23 January 1951. Inspired by the German Lippisch designs, it was almost a tailless delta, the wing actually being a curved swept wing of low aspect ratio with remarkable drooping slats and with elevons and outboard ailerons on the trailing edge. Another unusual feature was that the skin was composed of inner and outer layers of thin aluminium joined at a series of dimples on the inner skin to give stability. Yet another unusual choice was that the flight controls were fully powered, almost for the first time on a fighter, but in the event of failure the pilot could extend his telescopic control column to give increased leverage in the manual mode.

Designed to climb fast and steeply to intercept bombers attacking the fleet, the **F4D-1** (from its designation popularly called the 'Ford') was another US Navy type that began life with the Westinghouse J40 engine. This succeeded in setting a world speed record at 1211.5 km/h (752.8 mph) in 1953 but was actually a failure, and the J57 was fitted to the 420 production 'Fords' delivered in 1956-8. Thanks to its early inception the Skyray did not dispense with guns, and in service with US Navy and US Marine Corps squadrons it quickly established itself as a highly agile and popular aircraft. It was one of the first single-seaters to be equipped with a large all-weather interception radar fire-control system, the Westinghouse APQ-50/Aero 13. In two successive years the Skyray won the premier trophy awarded to the best of all fighter squadrons based in the USA, despite the fact it equipped the only non-USAF unit to compete.

In 1962 the Skyray was redesignated **F-6A**. By this time it was being replaced in first-line service by the F-4 and F-8, but a few survived with US Marine units in both intercept and ground attack missions until 1964.

Specification

Douglas F-6A Skyray
Type: single-seat carrier-based interceptor
Powerplant: one 6804-kg (15,000-lb) afterburning thrust Pratt & Whitney J57-8 turbojet
Performance: maximum speed 1162 km/h (722 mph) at sea level; range on internal fuel 1931 km (1,200 miles); service ceiling 16765 m (55,000 ft)
Weights: empty 7268 kg (16,024 lb); maximum take-off 12701 kg (28,000 lb)
Dimensions: span 10.21 m (33 ft 6 in); length 13.79 m (45 ft 3 in); height 3.96 m (13 ft 0 in); wing area 51.75 m² (557 sq ft)
Armament: four 20-mm Mk 12 cannon each with 70 rounds, plus seven external pylons for 1814 kg (4,000 lb) of bombs, rocket pods or four Sidewinder AAMs

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The Skyray could carry bombs or unguided rockets (illustrated) in the ground attack role, as well as the four wing-mounted 20-mm cannon. For interception duties, AIM-9 Sidewinders were usually carried. This example is from VFAW-3.

USA

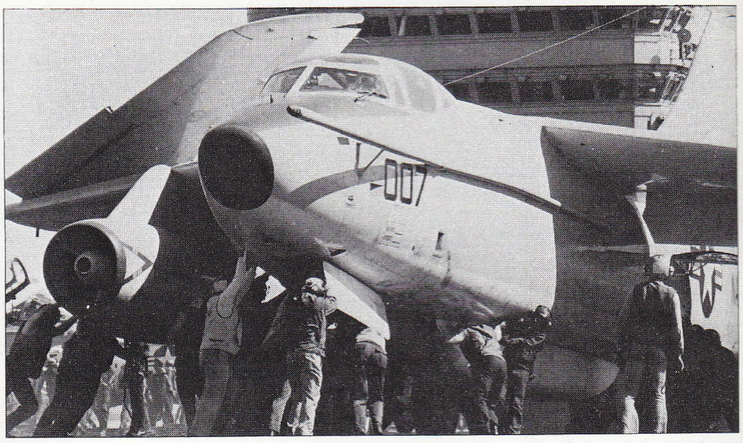
Douglas A-3 (A3D) Skywarrior

Representing a fantastic quantum jump in the capability of carrier-based attack aircraft, the prototype **Douglas XA3D-1 Skywarrior** flew in 1952, yet many of these great machines soldier on in the mid-1980s. Planned to fit the giant new 'Forrestal' class carrier, the A3D was almost a seagoing Boeing B-47, and it gave the US Navy nuclear retaliation capability all over the world. Ed Heinemann's design team at first said 'This is a Westinghouse airplane built by Douglas', because that supplier was responsible for the big podded engines, the defensive tail turret, the giant nose nav/bombing radar, the electrical system and many other items. But the engine was a failure and the **A3D-1** entered service in 1956 with the reliable J57, thereafter being standard equipment in the US Navy VAH heavy attack wings.

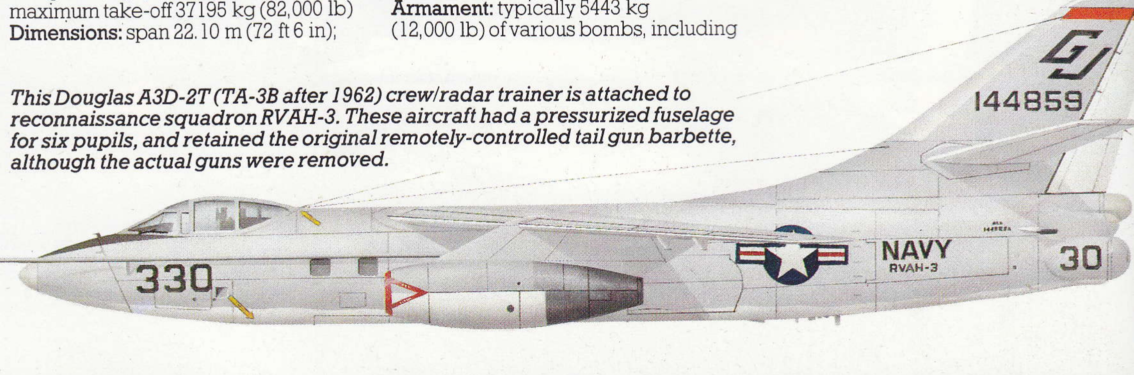
A three-seater, the A3D (redesignated **A-3** in 1962) has swept folding wings and folding vertical tail, giant fuselage airbrakes and a capacious weapons bay. Variants included the **RA-3B** five-seat reconnaissance aircraft with an impressive fit of cameras (12) and other sensors, the **EA-3B** seven-seat EW (electronic warfare) and ECM (electronic countermeasures) models with great electronic reconnaissance capability, the **TA-3B** eight-seat crew trainer, and the **KA-3B** tanker. Today only the tanker remains in use, though some are **EKA-3B** aircraft with various EW systems still installed. Despite the use of the Grumman KA-6D Intruder, the KA-3B is still often found aboard US Navy carriers, as well as being the standard heavy tanker for use from shore bases. Considering it was designed to a 1948 specification, the Skywarrior has had an amazingly long innings, and in its five major versions proved an ideal aircraft for many of the US Navy's most challenging missions throughout the 1960s.

Specification

Douglas A-3B Skywarrior
Type: three-seat carrier-based bomber
Powerplant: two 5625-kg (12,400-lb) thrust (wet rating) Pratt & Whitney J57-10 turbojets
Performance: maximum speed 982 km/h (610 mph) at 3050 m (10,000 ft); range on internal standard fuel 4667 km (2,900 miles); service ceiling 12500 m (41,000 ft)
Weights: empty 17876 kg (39,409 lb); maximum take-off 37195 kg (82,000 lb)
Dimensions: span 22.10 m (72 ft 6 in); length (excluding probe) 23.27 m (76 ft 4 in); height 6.95 m (22 ft 9.5 in); wing area 75.43 m² (812 sq ft)
Armament: typically 5443 kg (12,000 lb) of various bombs, including nuclear, plus two 20-mm cannon in radar-directed tail turret



The immense size of the Skywarrior is evident in this picture of USS Nimitz crewmen moving a VQ-1 EA-3B prior to launch. The Skywarrior has been operated in the electronic warfare role for nearly 20 years.



This Douglas A3D-2T (TA-3B after 1962) crew/radar trainer is attached to reconnaissance squadron RVAH-3. These aircraft had a pressurized fuselage for six pupils, and retained the original remotely-controlled tail gun barbette, although the actual guns were removed.

Carrier Aircraft in Vietnam

Naval aviation had its first hard work-out since the Korean war in the skies over Vietnam. Throughout the 11-year involvement, the US Navy continued the fine traditions first encountered by the Japanese during World War II. This time, however, there was to be no glorious victory.

At the controls of Vought F-8E Crusader 150924 of Fighter Squadron VF-211 from the carrier the USS *Ticonderoga* (CV 14), Commander Harold L. Marr turned round and saw a MiG-17 on his tail. It was 2 December 1966 over paddy fields north west of Hanoi, and Marr had just demonstrated the fighting mettle of the carrier-based F-8E by outmanoeuvring a MiG-17 and shooting it down with a heat-seeking AIM-9D Sidewinder missile. Now Marr heeded a wingman's warning, broke to the left, and allowed a second North Vietnamese fighter to pass him. Marr's earphones hummed with the tone revealing that the seeker head of his infra-red Sidewinder had locked on to the MiG. Marr fired his remaining missile, watched MiG and missile vanish into cumulus, and saw the quick glare of an explosion. His second kill of the day was a 'probable'. An hour later, the arresting hook of Marr's Crusader caught the 'trap' restraining wire on the *Ticonderoga*'s pitching flight deck and the F-8E pilot was home, having risen from the sea to fight in the air in a duel characteristic of sky battles fought by US naval aviation in the long Vietnam conflict.

Vietnam was a crucible for shipboard men and machines of the 1960s. Carrier aircraft in service at the outset of the decade faded away or acquired new roles as the Vietnam fighting heated up. The Douglas F-6A (F4D-1) Skyray and Grumman F-11A (F11F-1) Tiger were gone from ships' decks before hostilities began. The Douglas EF-10B (F3D-2) Skyknight two-seat twin-jet, designed as a night-fighter, served in Vietnam as an electronic warfare aircraft. The Vought F-8 Crusader and Douglas A-3 Skywarrior entered Vietnam combat in their intended roles as fighter and bomber, but by late in the decade were being used for reconnaissance and inflight-refuelling. North American's A-5 Vigilante never went into battle in its intended capacity as a bomber but was the most important reconnaissance aircraft of the war. Even the plucky Douglas A-4 Skyhawk, which fought heroically in the mid- and late-1960s, was gone from carrier decks by the decade's end. Ultimately, the Vietnam carrier war would be the province of aircraft which flew for the first time or began service in the 1960s, the McDonnell Douglas F-4 Phantom, Vought A-7 Corsair, and Grumman A-6 Intruder.

Using aircraft of the 1960s throughout, US Navy carrier aviation played a vital role in Vietnam from the Gulf of Tonkin incidents in 1964 until Operation 'Frequent Wind', the evacuation of Saigon, in April 1975. F-4B Phantom II fighters from the USS *Midway* (CVA 41) scored the first and last aerial victories of the war, shooting down a MiG-17 on 4 September 1965 and a MiG-21 on 12 January 1973. Even though US fighters had the added burden of being built for rugged, demanding operations from carrier decks, Crusaders and Phantoms proved themselves a match for Hanoi's potent MiG force, shooting down 67 MiGs while suffering only 17 losses in air-to-air combat. Attack planes, reconnaissance aircraft, tankers and helicopters proved during the South East Asia fighting that shipboard aircraft, designed, maintained and flown by professionals, are among the most formidable of weapons.

The carrier force

At least one attack carrier (CVA) was always at 'Dixie' Station off the coast of South Vietnam, for strikes against Viet Cong guerrillas in the south, and another at 'Yankee' Station in the Gulf of Tonkin to assault the heartland of North Vietnam. Carrier aircraft really fought three separate wars: ground-attack and close-

In the hot and humid climate of the South China Sea, ground crew prepare a Douglas A-4 Skyhawk for another mission against Communist forces in Vietnam. The Skyhawk was to become the major light attack aircraft for the US Navy throughout the campaign.

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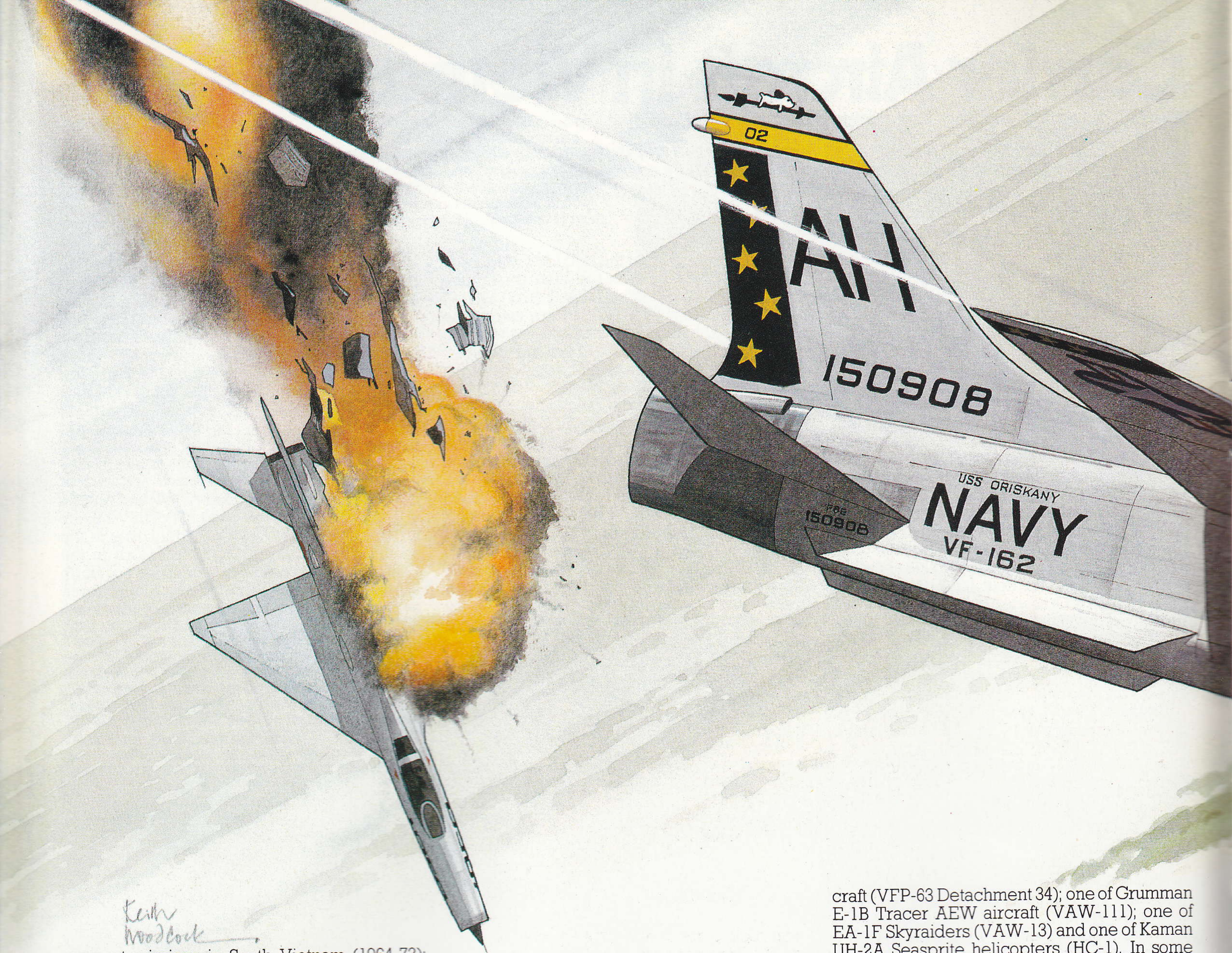


support missions in South Vietnam (1964-73); the 'Rolling Thunder' campaign against North Vietnam (1965-8) which ended with a temporary bombing halt; and the 'Linebacker' operations against North Vietnam (1972-3), which finally pressured Hanoi into a settlement. During the final stages, as many as three carriers were positioned off North Vietnam.

'Flat-tops' varying in size from the World War II USS *Hancock* (CVA 19) to the nuclear-powered USS *Enterprise* (CVAN 65) had to expect enemy attack even though they remained largely untouched throughout the war, and crews of up to 4,000 men lived in constant tension while carrying out duties which, even in peacetime, are extremely dangerous. Deck crews who worked with powerful steam catapults and risky arresting gear shared the credit for combat success with men who routinely allowed themselves to be slammed into the sky from heaving, pitching carrier decks. Dramatic incidents proved that carriers could be threatened: during the mining of Haiphong harbour by A-7 Corsairs, for example, a MiG was shot down by a ship-launched Talos surface-to-air missile before it could reach the USS *Coral Sea* (CVA 43).

A carrier air wing was typically equipped with two or three attack, two fighter and one reconnaissance squadrons, with detachments of tankers, airborne early warning (AEW) aircraft and helicopters. An illustrative 'mix' of aircraft was found on USS *Oriskany* (CVA 34), a 39,700-ton veteran built just after World War II and used throughout the Vietnam conflict. On its 26 May-16 November 1966 West Pacific/Vietnam cruise, the 'Big O' carried all or part of 10 squadrons: two of F-8C Crusaders (VF-111 and VF-162); two of A-4E Skyhawks (VA-163 and VA-164); one of A-1H Skyraiders (VA-152); one of A-3B Skywarriors (VAH-4 Detachment G); one of RF-8G Crusader reconnaissance aircraft (VFP-63 Detachment 34); one of Grumman E-1B Tracer AEW aircraft (VAW-111); one of EA-1F Skyraiders (VAW-13) and one of Kaman UH-2A Seasprite helicopters (HC-1). In some carrier air wings, US Marine Corps aircraft were assigned, the corps' VMFA-333 squadron in F-4J Phantoms on the USS *America* (CVA 66) scoring the sole US Marine carrierbased MiG kill of the war.

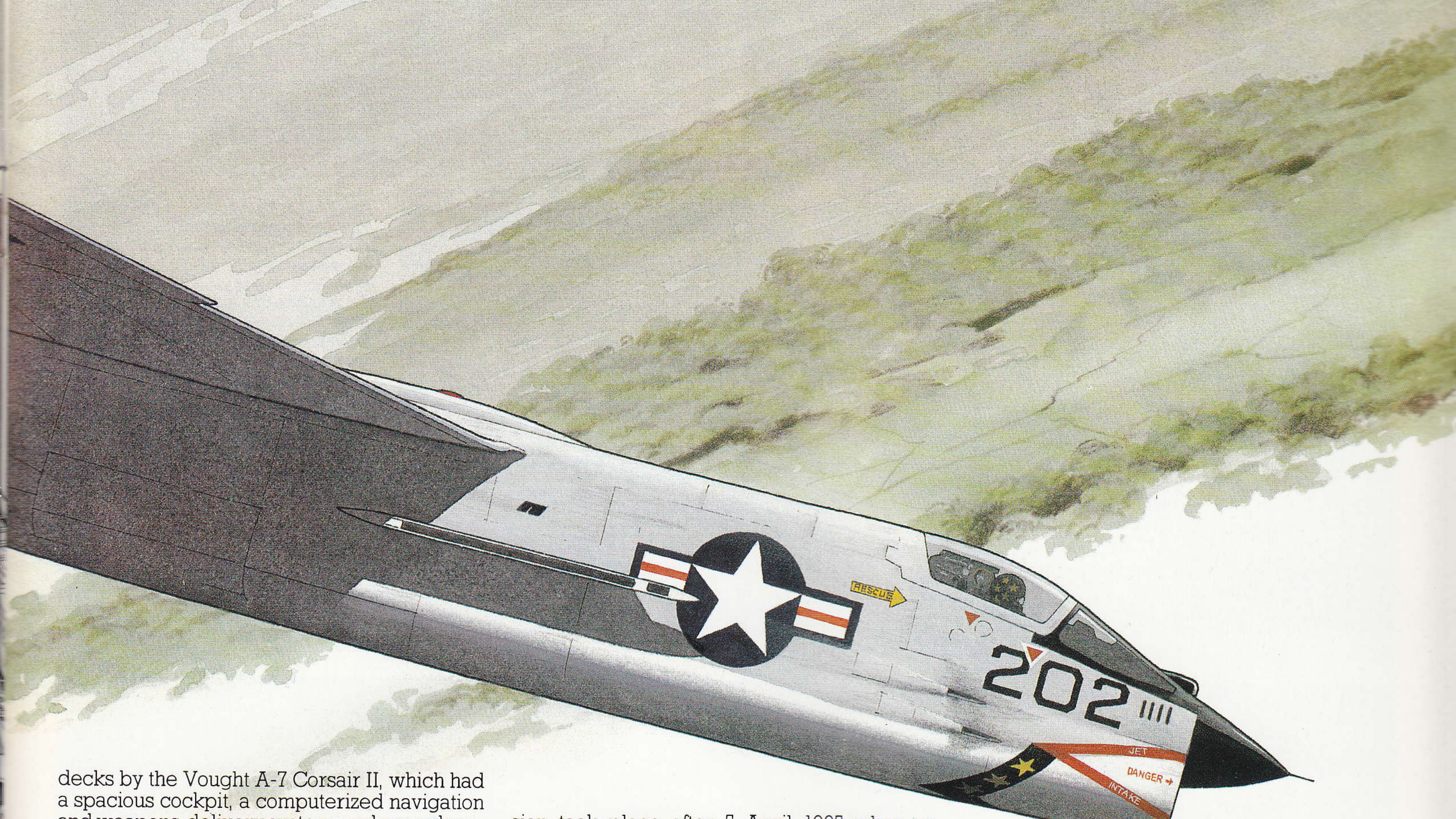
Fighters provided MiG combat air patrol (MiGCAP) to shield the fleet and its attack aircraft from enemy interceptors, but were used, too, in the strike role, the sight of a Crusader or Phantom with bombs and rockets being a familiar one to enemy ground troops. Carrier aviation's real punch came from the 'Alpha Strike', a daytime mission by attack aircraft under visual flying conditions, to deliver rocket projectiles and/or iron bombs to enemy targets. On strike missions in South Vietnam, Skyhawk or Corsair pilots held no option over the choice of targets, being directed to Viet Cong strongholds by forward air controllers and requiring formal clearance before expending ordnance, in order to avoid strikes on civilian targets. North Vietnam was 'free', attack pilots being authorized to roam the North in search of targets of opportunity.

Several aircraft were painted in an experimental green camouflage during the war. The scheme was dropped as the deck crew found it difficult to handle the aircraft during night operations. Among the types converted were the A-4 Skyhawk, RA-5 Vigilante and the A-6 Intruder.

The aircraft

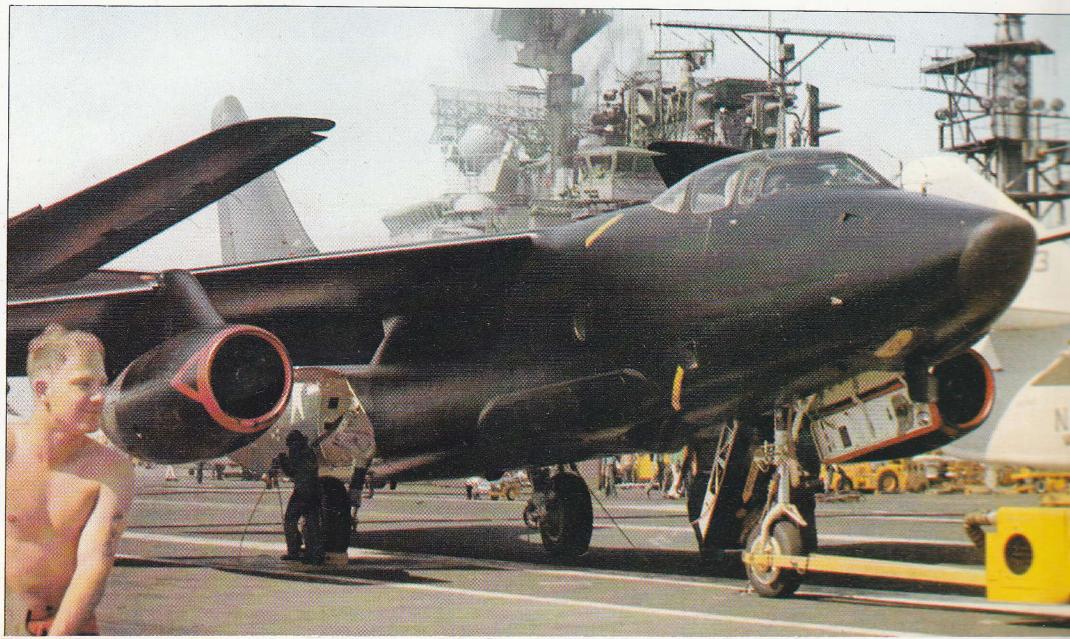
The Douglas A-4 Skyhawk light attack aircraft, although universally loved by pilots and able to absorb punishing anti-aircraft artillery damage, will be remembered by some for its cramped cockpit and limited range. By the late 1960s, it had been superseded on carrier

One of the most famous actions of the war occurred when Commander Dick Bellinger, skipper of VF-162 flying from USS Oriskany, shot down the first MiG-21 for the Navy in his Vought F-8E Crusader. Bellinger used two Sidewinder missiles to hit the MiG, which was manoeuvring hard. Following the hit, Bellinger found himself too low and had to wrestle the aircraft out of its dive, pulling out just above the trees.



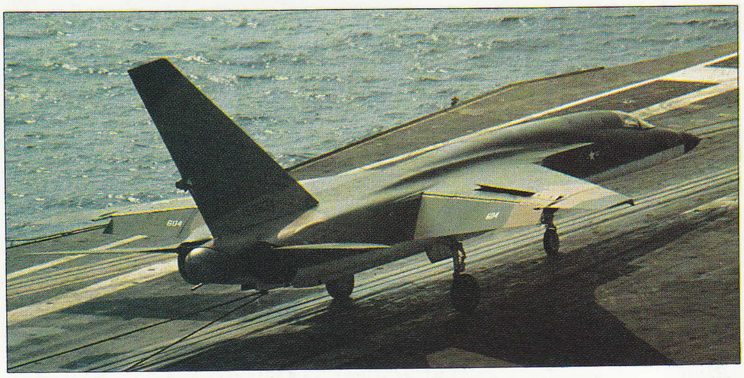
decks by the Vought A-7 Corsair II, which had a spacious cockpit, a computerized navigation and weapons-delivery system, and enough endurance to prowl the entire North Vietnamese coastline on a single mission. On carrier decks, the low-slung, gaping air inlet for the A-7's turbofan engine had a way of ingesting loose objects (and people, there being no grille ahead of the engine stator blades) but aloft the 15,000-lb (6804-kg) thrust Allison TF41-A-2 (a US development of the Rolls-Royce Spey) propelled a rugged aircraft of great ordnance-carrying capability. Although the A-7 also has some all-weather capability, the night and bad-weather champion in carrier operations in Vietnam was another product of the 1960s, the Grumman A-6 Intruder, the sole embarked strike aircraft of its day to possess full all-weather capability and the potential for a single-pass attack.

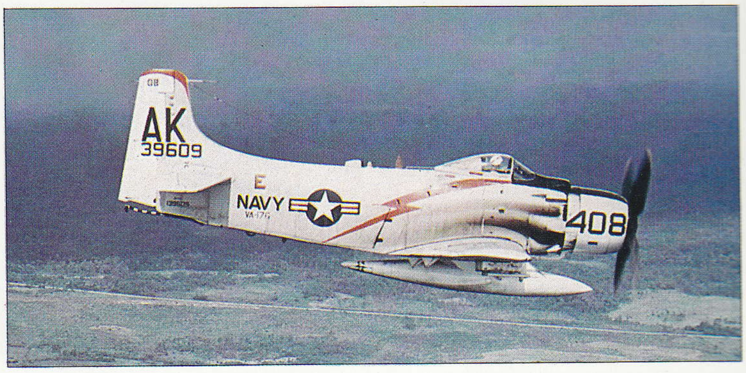
Covered by their own fighter force, attack pilots flying from carrier decks flew every kind of mission: assaulting truck convoys, dropping bridge spans, hitting petrol, oil and lubricant (POL) facilities and laying mines. Their job, of course, was dictated by policy-makers who wanted to use force of arms to pressure Hanoi into a negotiated end to the fighting, a goal that was eventually achieved. An illustrative mission took place after 5 April 1965 when an RF-8G Crusader returned to the USS *Coral Sea* (CVA 43) with the first photos of a North Vietnamese surface-to-air missile site under construction. An 'Iron Hand' or SAM suppression effort was mounted by A-4E Skyhawks of Squadron VA-23 from the USS *Midway* (CVA 41), which assaulted the enemy positions on 12 August 1965 using AGM-65 Shrike anti-radar missiles (ARM) which homed on North Vietnamese electronic emissions. These attacks continued throughout the war, a daring Shrike/'Iron Hand' mission being carried out by Commander Lewis W. Dunton III in an A-7A Corsair of Squadron VA-37 on the USS *Saratoga* (CVA 60) under a quarter-moon in the dead of night on 18 December 1972. By that date, the issue was almost decided. Bred and tempered in the 1960s, US Navy carrier pilots and planes continued the battle until its end.

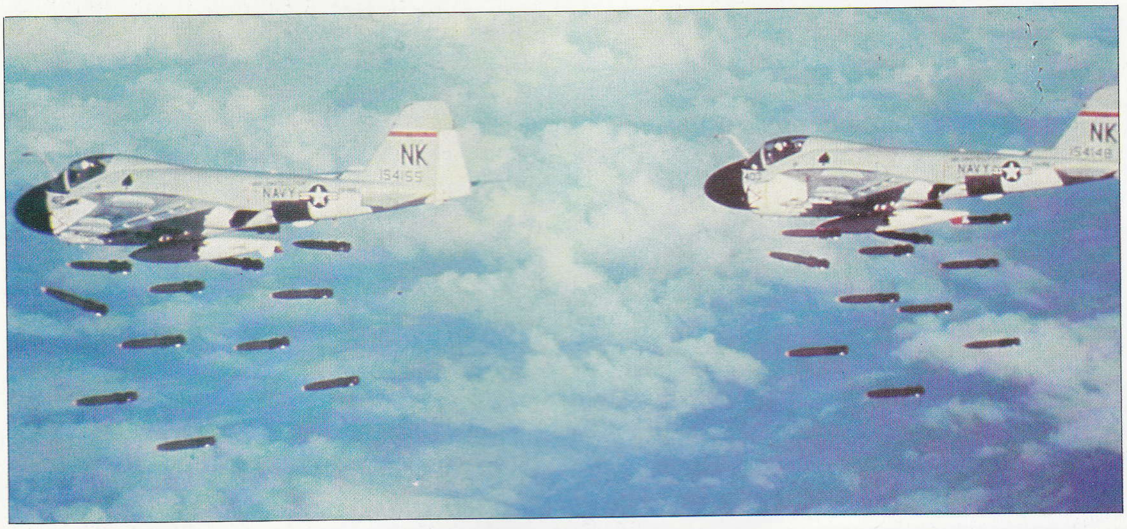


Several Douglas RA-3 Skywarriors were painted black for clandestine reconnaissance missions over Vietnam. The scheme was not adopted for major use. The RA-3 carried video real-time cameras as well as special film which could differentiate between live foliage and camouflage.

Carrier Aircraft in Vietnam







Above left: The North American RA-5 Vigilante provided tactical reconnaissance alongside RF-8 Crusaders.

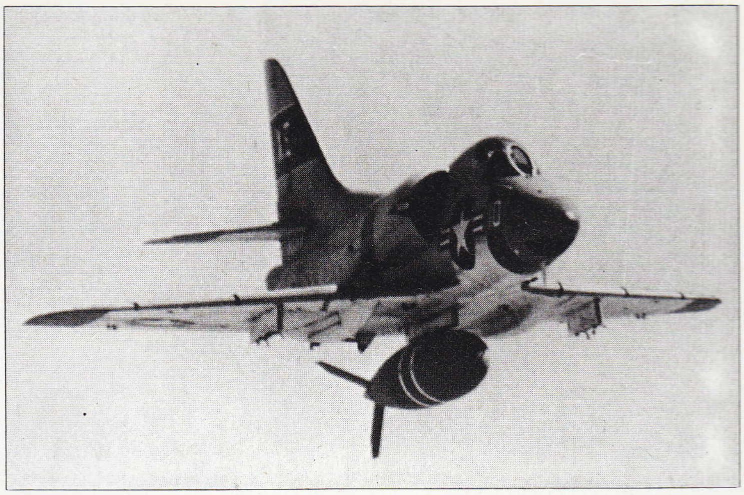
Above: The venerable Douglas A-1 Skyraider continued to serve in the attack role until 1968 on the smaller carriers.

Left: Possessing devastating blind first-pass attack capability, the Grumman A-6 Intruder greatly increased the US Navy's options. This pair drops 12 Snakeye retarded bombs each.

Below: A shark-mouthed Crusader receives the launch signal from the Catapult Officer aboard USS Oriskany. It is loaded with four Sidewinders on 'Y-racks' for the MiGCAP role.

USA

Douglas (McDonnell Douglas) A-4 (A4D) Skyhawk



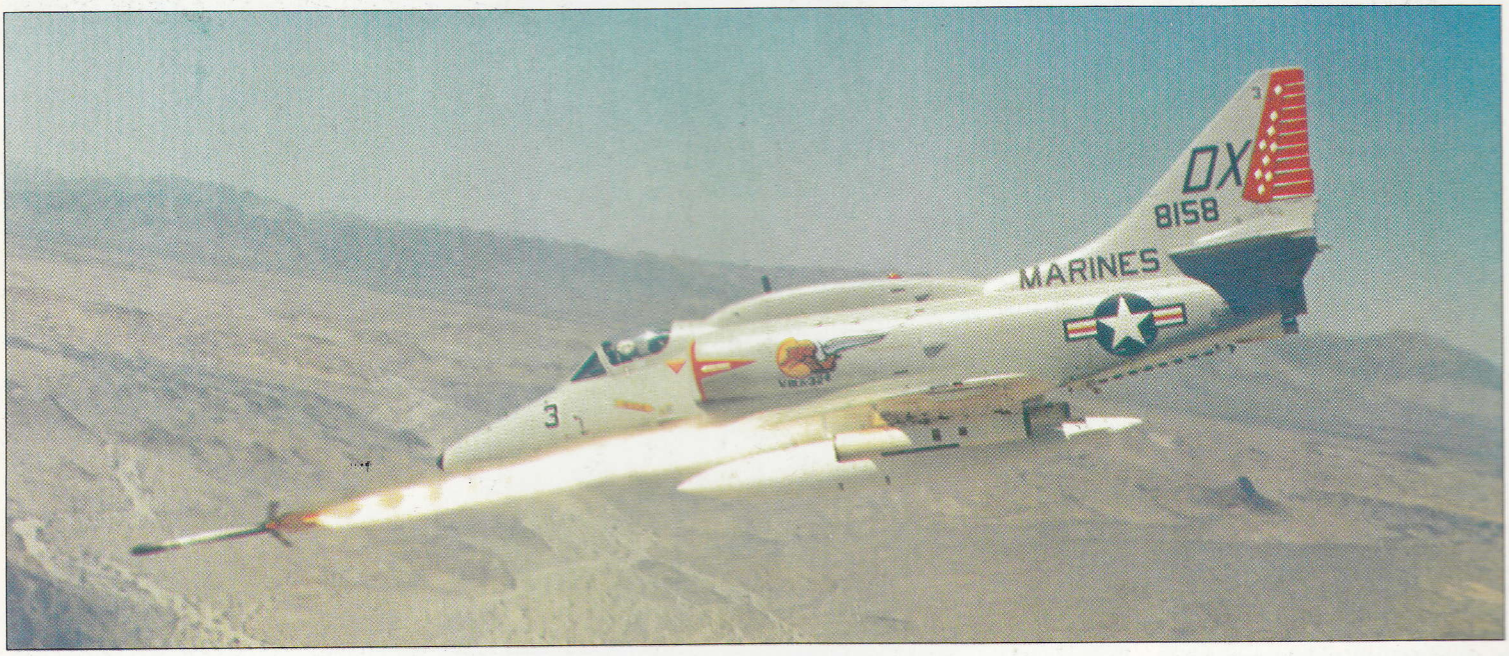
This A-4 Skyhawk was employed by VX-5 at the Navy's test centre at China Lake on aerodynamic tests for airborne nuclear weapons.

Another of the brilliant designs of Ed Heinemann at the El Segundo plant, the **Douglas A4D Skyhawk** jet attack aircraft came out at just half the weight the US Navy predicted, and was also dramatically faster. The engine chosen was the British Armstrong Siddeley Sapphire (licence-built as the Wright J65), which was placed above a wing made in the form of an integral tank from tip to tip and so small it did not have to fold. The long main gears were arranged to retract forwards without cutting into the wing except for the wheel bay ahead of the front spar. Everything possible was done to simplify the design. The prototype flew on 22 June 1954, and soon set a world 500-km (311-mile) circuit speed record. The **A4D-1** (later **A-4A**) entered service in 1956.

So good was the Skyhawk that termination of production was postponed until 1979, when the 2,960th and last example came off the line. There were 14 basic variants, some purely for export, and many later sub-types produced by conversions. The chief alteration during production was the switch to the J52 engine in the **A-4E** of 1961, giving more thrust and slightly better range. Throughout the early 1960s the J65-engined **A-4C** was the main version, serving with 23 US Navy and US Marine attack squadrons, but this gave way to the A-4E and the greatly updated **A-4F** which was the first with a 'camel hump' fairing for Bullpup guidance and other extra avionics. All models from the A-4E have five pylons, as well as provision for an in-flight-refuelling probe on the right side of the nose. The **TA-4F** and simplified **TA-4J** are major tandem dual trainer versions, and the ultimate new-build single-seater was the **A-4M Skyhawk II** with a square-tip fin (later fitted with an ECM pod), new windshield and canopy, drag chute and many other updates. The **OA-4M** is a rebuilt two-seat TA-4F for forward air control duties with very comprehensive avionics. Among the many export versions Israel's completely rebuilt **A-4N** is distinguished by long anti-missile jetpipes, while Singapore's **TA-4S** has two separate cockpit windshields and canopies.

Specification

Douglas A-4M Skyhawk II
Type: single-seat carrier-based attack aircraft
Powerplant: one 5080-kg (11,200-lb) thrust Pratt & Whitney J52-408A turbojet
Performance: maximum speed, clean at sea level 1078 km/h (670 mph); combat radius with external weapons on a hi-lo-hi mission 620 km (385 miles); service ceiling 12880 m (42,250 ft)
Weights: empty 4899 kg (10,800 lb); maximum take-off 11113 kg (24,500 lb)
Dimensions: span 8.38 m (27 ft 6 in); length (with or without probe) 12.29 m (40 ft 4 in); height 4.57 m (15 ft 0 in); wing area 24.15 m^2 (260 sq ft)
Armament: two 20-mm Mk 12 cannon each with 200 rounds, plus one centreline pylon rated at 1587 kg (3,500 lb), two inboard wing pylons each rated at 1021 kg (2,250 lb) and two outboard wing pylons each rated at 454 kg (1,000 lb)



A late-model A-4M of Marines squadron VMA-324 fires a Zuni air-to-ground unguided rocket at a range in California.

USA

Grumman S-2 (S2F) Tracker

First flown on 4 December 1952, the **Grumman XS2F-1** prototype had its genesis in a US Navy specification two years earlier demanding the previously unattainable quality of being able to operate from a small (i.e. not a giant 'Forrestal' class) carrier whilst carrying both ASW (anti-submarine warfare) sensors and weapons to effect the kill. Previously the task had demanded two aircraft operating in a hunter/killer team. Grumman's G-89 design was a basically conventional aircraft with a high wing of long span, two piston engines and a cabin ahead of the wing for two pilots and two radar and sensor operators.

It was no easy job to package all the required items into a compact airframe. The APS-38 radar was put in the rear fuselage, the radome being winched down for use. A searchlight was installed on the outer right wing, and the MAD (magnetic anomaly detector) was mounted on a tube which could be extended from the rear fuselage well aft of the tail. Sonobuoys could be ejected from the rear of the engine nacelles, and weapons were carried in an internal bay and also on six wing pylons.

From the start of operational service in February 1954 the **S2F-1**, named **Tracker**, did all that was asked. Production continued until after 1960 and there were many conversions and rebuilds, the later models having APS-88 radar, twice as many sonobuoys (32),

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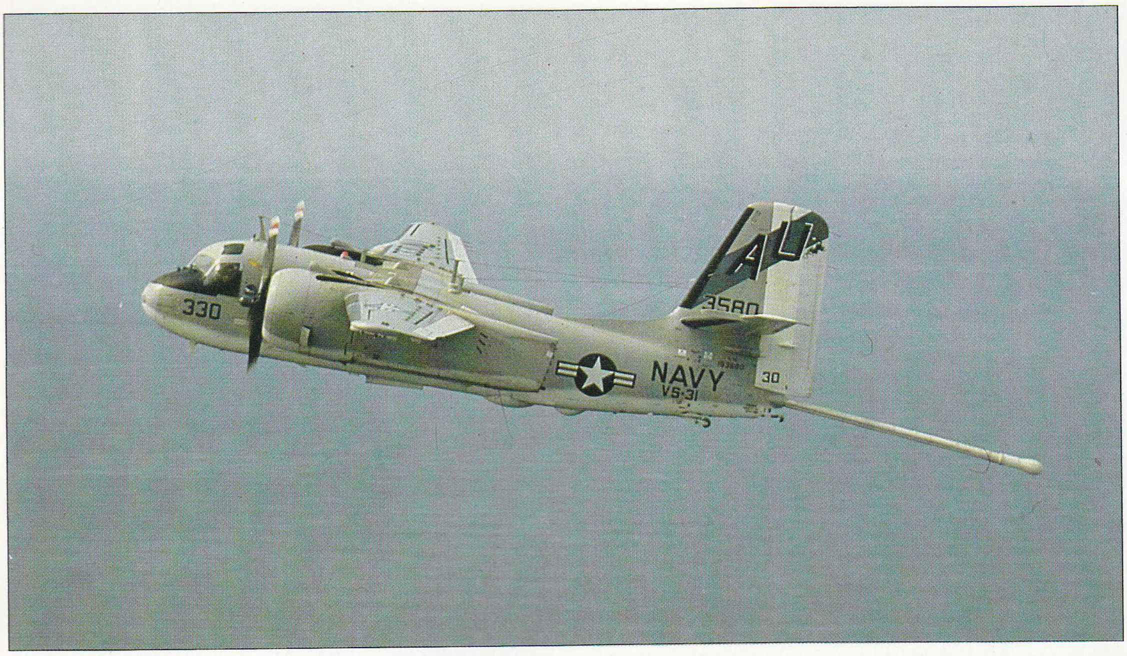
These two Grumman C-1 Traders are seen on a regular supply mission to a US Navy carrier. The Trader could carry up to nine passengers as well as cargo in the fully-equipped hold.



This VS-31 S-2 Tracker displays the main sensor used by the aircraft for detecting submarines, the magnetic anomaly detector. This retracts back into the fuselage when not in use. The idea of the extendable sting is to take the detector gear as far away from the metal aircraft as possible.

Julie/Jezebel detection gear, increased wing span and tail area and numerous improved avionics systems. The last major addition was the AQA-7 Difar sonobuoy processing system. Over 1,170 Trackers were built, not including 100 **CS2F-1 Tracker** aircraft built at Toronto by DH Canada. From 1962 the designation was changed to **S-2A** to **S-2G**, depending on model.

Many S-2 Tracker ASW aircraft were later converted into **US-2C** aircraft and various other utility versions used as hacks and for general trucking duties. In addition Grumman was contracted to supply the US Navy with a specially designed transport for COD (carrier on-board delivery) missions, which involves supplying a carrier at sea with personnel, mail and all urgently needed stores. The requirement dated from 1950, but pressure of other work delayed the G-96, which appeared in 1955 as the **Grumman TF-1 Trader**, the designation actually meaning trainer (a secondary role). In the rationalized USAF/US Navy scheme of 1962 the Trader was redesignated **C-1A**.

Using the wing, engines and many other parts of the S-2 Tracker, its tail being of the enlarged type introduced with the S-2D, the C-1A was given a new fuselage with increased volume, providing sufficient room for nine strong 9g aft-facing passenger seats, or a cargo load of 1587 kg (3,500 lb). All loads go on board via side doors, large items and small vehicles not being compatible. Of course full carrier compatibility is retained, the fully loaded aircraft making arrested landings and catapult take-offs.

Grumman delivered 87 production C-1A Traders, as well as four of the G-125 version which entered Navy service in 1957 as the **TF-1Q** specialized ECM (electronic countermeasures) platform with the main cabin taken over by high-power receivers and jamming systems. In 1962 these little-publicized machines were redesignated as **EC-1A**.

Eventually, from 1965, the Trader began to be replaced by the much more powerful Grumman C-2A Greyhound, but a few continued in second-line service until the end of the decade.

Specification
Grumman S-2E Tracker

Type: four-seat carrier-based ASW aircraft

Powerplant: two 1,525-hp (1137-kW) Wright R-1820-82WA Cyclone piston engines

Performance: maximum speed 426 km/h (265 mph) at sea level; patrol speed 240 km/h (149 mph); range 1850 km (1,150 miles); endurance 9 hours

Weights: empty 8633 kg (19,033 lb); maximum take-off 12187 kg (26,867 lb)

Dimensions: span 22.12 m (72 ft 7 in); length 13.26 m (43 ft 6 in); height 5.05 m (16 ft 7 in); wing area 46.08 m^2 (496 sq ft)

Armament: internal bay and six pylons for total load up to 2182 kg (4,810 lb) including AS torpedoes, depth bombs and rockets

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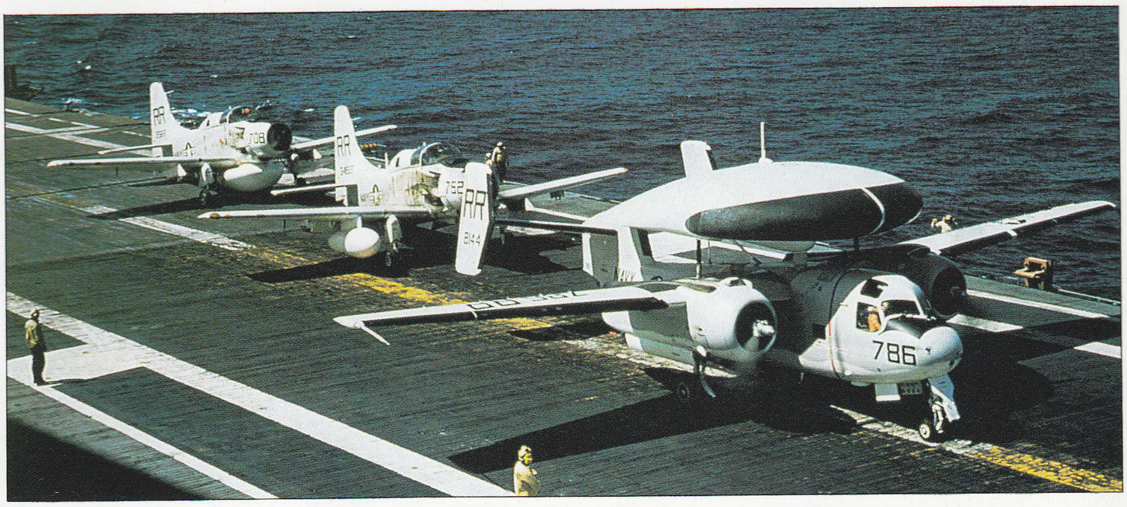
USA

Grumman E-1 (WF-2) Tracer



Seen with its predecessor, the Douglas EA-1 Skyraider, this Grumman E-1B Tracer prepares for launch from the wooden decks of USS Oriskany. The radical carriage of the radar antenna is clearly visible.

In 1954 the success of Lockheed Super Constellations and other US Navy aircraft tested in the high-flying AEW (airborne early warning) role, which then was called radar picket duty, caused Grumman to receive a contract for a development of the S2F-1 Tracker specially configured to carry a large surveillance radar. This aircraft, the **WF-1**, never flew; instead the company type number G-117 was carried over to a radar-carrying development of the more capacious C-1A Trader, the **Grumman WF-2**, with the bigger wing and tail. The C-1A (then TF-1) BuNo 136792 was fitted with a mock-up of the proposed radome and tail to serve as the aerodynamic prototype. This flew on 1 March 1957 and the first of 88 production machines, named **Tracer** and after 1962 redesignated as **E-1B**, flew on 2 February 1958. (The new designation arrived too late to prevent the unofficial name, from the WF designation, becoming 'Willy Fudd'.)

The radar used in the Tracer was the AN/APS-82, with the main racking filling the centre and rear fuselage and the rotating aerial (antenna) housed inside an unusual aerofoil-profile radome like a vast teardrop saucer carried on struts above the fuselage. The front of this fixed radome had a de-icer boot larger than any previously made, while at the rear it was extended to join the centre fin of the completely redesigned three-fin tail. The two operators amidships worked at identical consoles but with different duties, managing not only the main radar but also extensive IFF and communications systems, the two pilots handling navigation. In service as detachments of VAW-11 and VAW-12 the Tracer pioneered shipboard early-warning and fighter direction, being replaced by the much more powerful E-2A Hawkeye from 1964.

Specification
Grumman E-1B Tracer

Type: four-seat AEW surveillance and control aircraft

Powerplant: two 1,525-hp (1137-kW) Wright Cyclone R-1820-82WA piston engines

Performance: maximum speed 402 km/h (250 mph) at medium altitudes; operating height 6095 m (20,000 ft); maximum endurance 8 hours

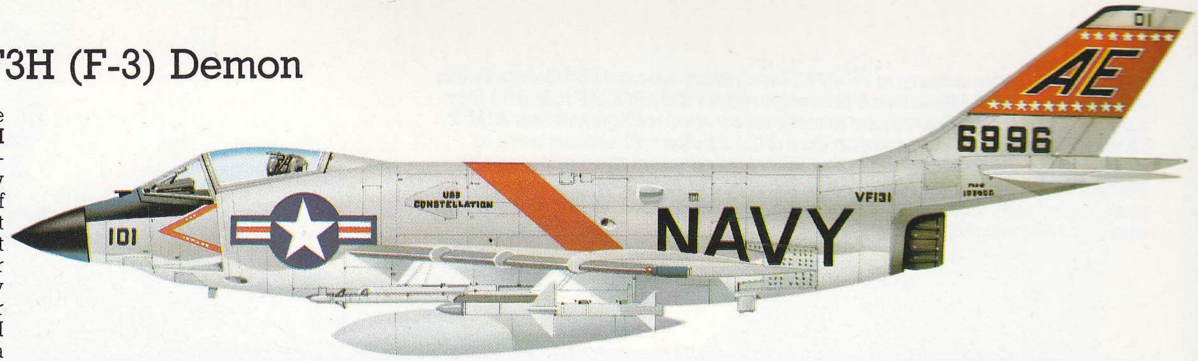
Weights: empty 9536 kg (21,024 lb); maximum take-off 12232 kg (26,966 lb)

Dimensions: span 22.05 m (72 ft 4 in); length 13.82 m (45 ft 4 in); height 5.13 m (16 ft 10 in); wing area 47.0 m^2 (506 sq ft)

Armament: none

USA

McDonnell F3H (F-3) Demon



McDonnell F3H-2 Demon of VF-131 based on the USS Constellation *in the early 1960s.*

Like the contemporary Supermarine Swift in the UK, the **McDonnell F3H Demon** was sustaining a big production programme when it was belatedly recognized that the aircraft pouring off the line were unacceptable; a great outcry ensued as dozens of aircraft were scrapped or put aside for later rework. McDonnell knew the fault lay solely with the J40 engine, and after years of trauma got a redesigned F3H into US Navy service where it proved a fine aircraft.

When the **XF3H-1** prototype flew on 7 August 1951, it was structurally and aerodynamically the most advanced navy aircraft in the world. All wing and tail surfaces were acutely swept, the wing having fully variable camber and the tailplane being a slab. During flight testing the US Navy demanded extra fuel and all-weather radar, and the J40 engine proved totally unable to cope with the increased weight. McDonnell eventually, in 1954, redesigned the aircraft with the J71 engine, with still more fuel and a bigger wing. Production at last went ahead with 519 in three main models. The **F3H-2** (**F-3B** after 1962) was the basic strike fighter, 239 being delivered. These had the new airframe and engine but retained the original Hughes APG-51 radar matched with gun armament, four wing pylons being added for attack loads. McDonnell delivered 80 **F3H-2M** (later called **MF-3B**) aircraft which had augmented avionics for all-weather interception and a CW (continuous-wave) target illuminator for use with the primary air-to-air armament of four AIM-7C Sparrow III missiles, the first time these entered service. The **F3H-2N** (**F-3C**), of which 144 were delivered, was a limited all-weather fighter with basic APG-51 radar and four Sidewinder AAMs of the radar-guided AIM-9C variety.

Demons had a very active career, seeing combat duty around Quemoy and off the Lebanon in 1958. Last deliveries took place in 1959 and replacement by the McDonnell F-4 was complete by August 1964 (first line) and February 1965 (reserve).

Specification
McDonnell F-3C Demon (F3H-2N)

Type: single-seat carrier-based fighter
Powerplant: one 6350-kg (14,000-lb) afterburning thrust Allison J71-2 or -2E turbojet
Performance: maximum speed, clean at sea level 1170 km/h (727 mph); range 2205 km (1,370 miles); service ceiling 13000 m (42,650 ft)
Weights: empty 9656 kg (21,287 lb); maximum take-off 15161 kg (33,424 lb)
Dimensions: span 10.77 m (35 ft 4 in); length 17.98 m (59 ft 0 in); height 4.44 m (14 ft 7 in); wing area 48.22 m² (519 sq ft)
Armament: four 20-mm Mk 12 cannon, plus four wing pylons for AIM-9C Sidewinder AAMs or up to 2722 kg (6,000 lb) of various attack weapons

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A Demon of VF-61 'Jolly Rogers' launches. The severe delay in development meant that the F3H-2 had to compete with the F8U Crusader, but the Sparrow III did much to redress the balance.

USA

McDonnell F-4 Phantom II

Produced as a private company venture in the mid-1950s, the **McDonnell Phantom II** was first ordered as the **AH-1** attack aircraft but then became the **F4H** interceptor with only a single centreline pylon for a giant drop tank. Guns were deleted, four Sparrow III AAMs were recessed under the broad flat belly, a powerful Westinghouse AN/APQ-50 Mod radar was added along with a radar operator in the back seat, and the first of 23 test aircraft flew on 27 May 1958. Though large, their splendid propulsion system, installed between fully variable inlets and nozzles with carefully arranged secondary flow, gave all-round flight performance never attained by any fighter. Early F4H (**F-4A**) aircraft captured almost every world record for speed at low and high altitudes, time to height and other parameters, so that it was also bought in vast numbers as a land-based fighter for air forces.

The initial carrier-based model was the **F-4B**, of which 649 were built (including 12 **F-4G** aircraft with different radio). This had a bulged nose to house the 810 mm (32-in) dish of the AN/APQ-72 radar and a raised rear seat. It went to sea in August 1962 and became the standard all-weather fighter with the US Navy and US Marines, the latter service also buying 46 unarmed **RF-4B** multi-sensor reconnaissance aircraft. Service experience led to the **F-4J** of 1965, with the AWG-10 fire-control system, an extra tank, slotted tailplane, drooping ailerons, bigger wheels and brakes and (as a modification) ECM fin cap. This replaced the F-4B model in the US Navy and US Marines, 522 being built, and today survivors have been updated and fitted with slatted wings as the **F-4S**.

The UK's Royal Navy bought 24 **F-4K** aircraft similar to the F-4J but with Rolls-Royce Spey engines, AWG-11 with radar in a hinged nose, double-extension nose leg and other changes, another 28 going to the RAF (designation **Phantom FG.Mk 1**) which today has all surviving Phantom FG.Mk 1s. The RAF and many other air forces purchased land-based versions.

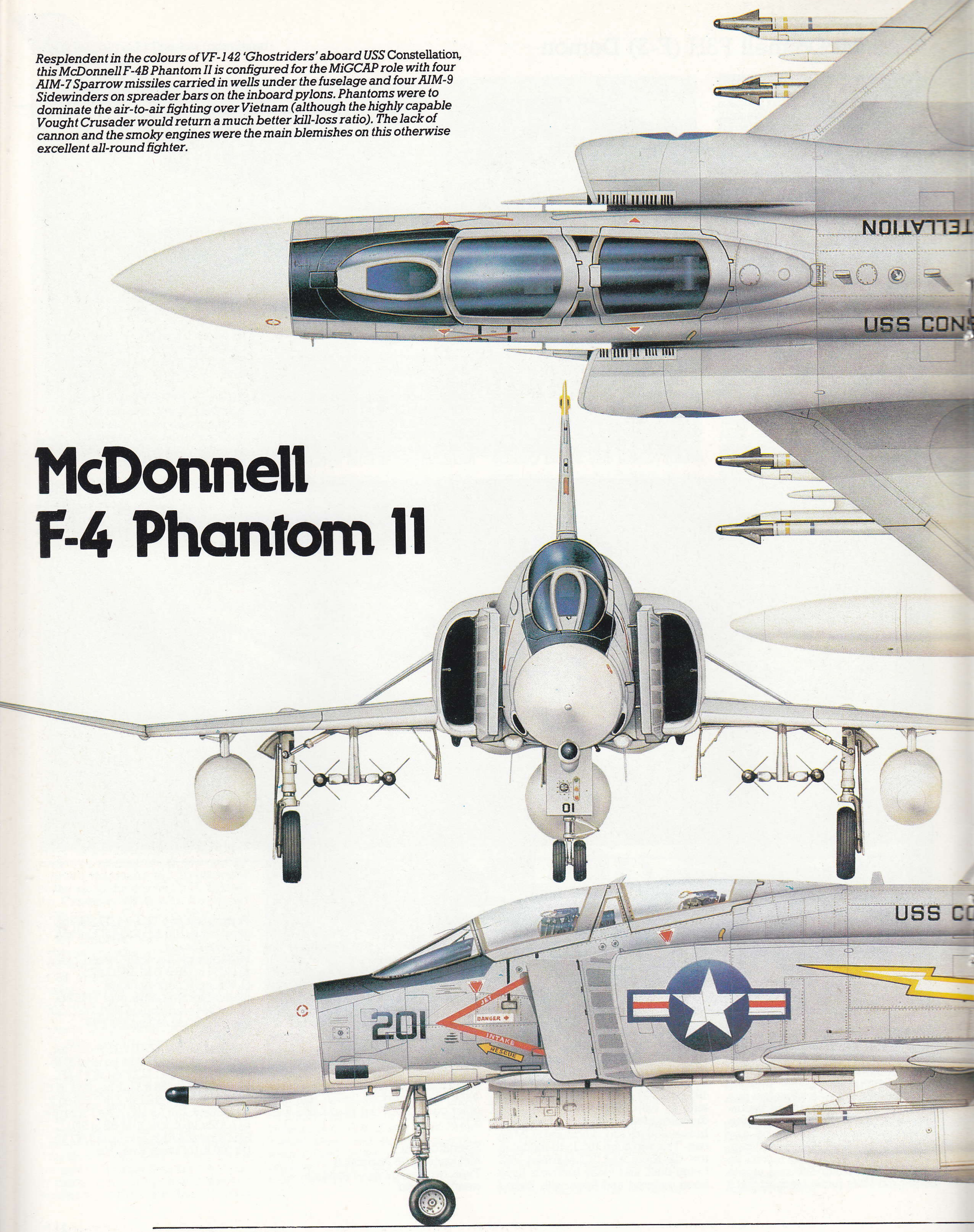
The F-4 was the world's premier fighter of the 1960s. It saw extensive combat duty in Vietnam and has also been much used by Israel, Iran and other countries. Total production was 5,177.

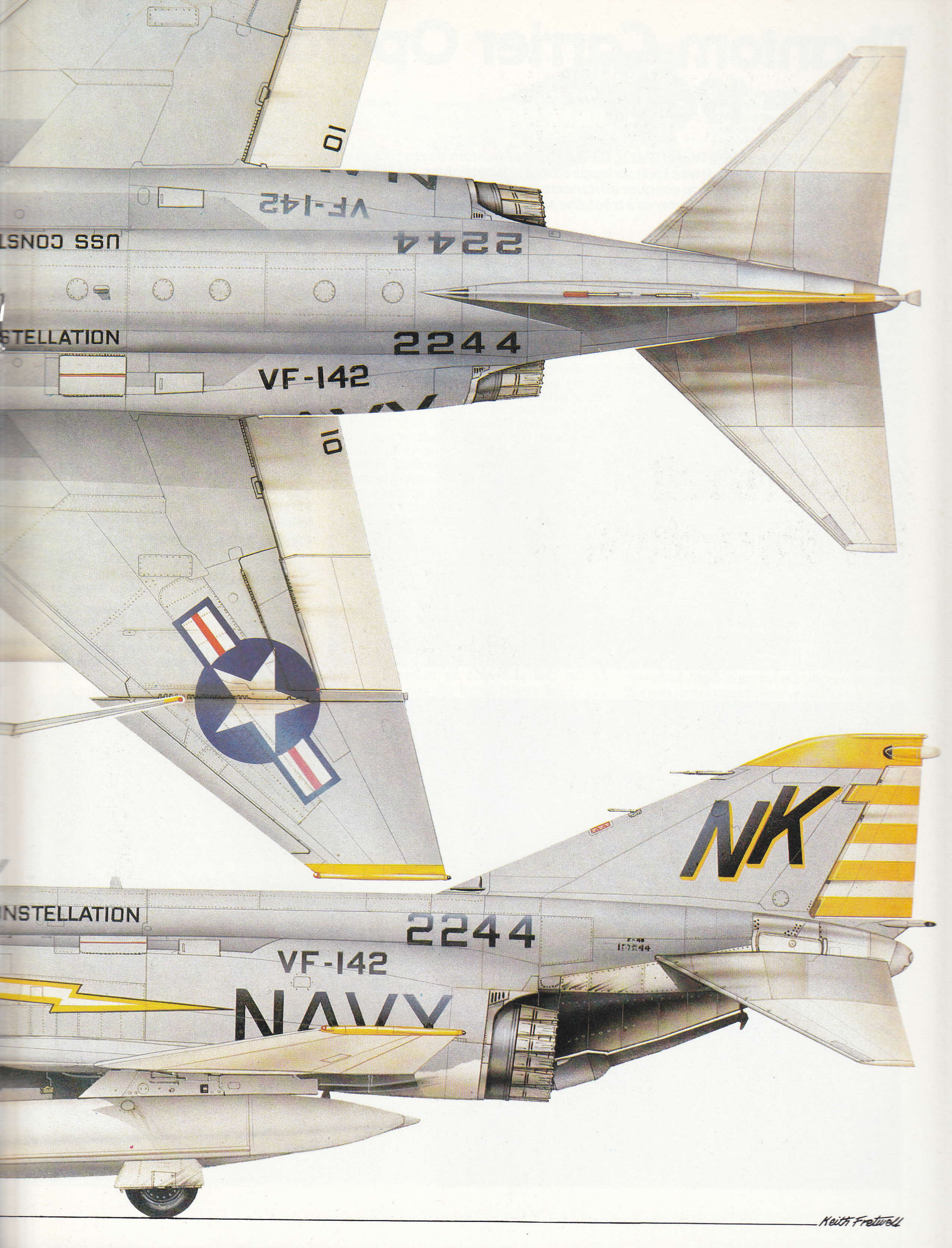
Specification
McDonnell F-4B Phantom II

Type: two-seat carrier-based all-weather fighter
Powerplant: two 7711-kg (17,000-lb) afterburning thrust General Electric J79-8B turbojets
Performance: maximum speed, clean at 14630 m (48,000 ft) 2390 km/h (1,485 mph); combat radius interceptor with tanks, over 1448 km (900 miles); ferry range 3701 km (2,300 miles); service ceiling 18900 m (62,000 ft)
Weights: empty 12700 kg (28,000 lb); maximum take-off 24766 kg (54,600 lb)
Dimensions: span 11.71 m (38 ft 5 in); length 17.75 m (58 ft 3 in); height 4.95 m (16 ft 3 in); wing area 49.2 m² (530 sq ft)
Armament: four (or six) AIM-7 Sparrow III AAMs, up to four AIM-9B or 9D Sidewinder AAMs, and up to 7257 kg (16,000 lb) of attack weapons

Resplendent in the colours of VF-142 'Ghostriders' aboard USS Constellation, this McDonnell F-4B Phantom II is configured for the MiGCAP role with four AIM-7 Sparrow missiles carried in wells under the fuselage and four AIM-9 Sidewinders on spreader bars on the inboard pylons. Phantoms were to dominate the air-to-air fighting over Vietnam (although the highly capable Vought Crusader would return a much better kill-loss ratio). The lack of cannon and the smoky engines were the main blemishes on this otherwise excellent all-round fighter.

McDonnell F-4 Phantom 11

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Phantom Carrier Operations in the 1960s

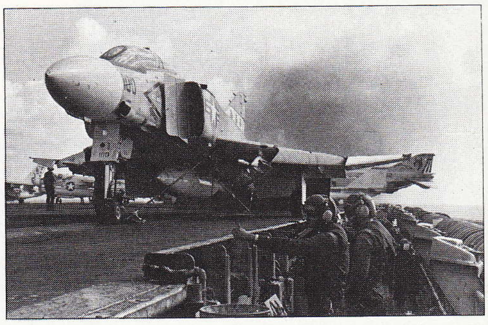
The best-known fighter since World War II, the incredible Phantom started life as a carrierborne attack aircraft. It was soon redesigned as a missile fighter, where its power and strength were soon to conquer all its enemies. Although its heyday was in the 1960s, the Phantom lives on today as a front-line aircraft.

In the Kennedy era, in a radical new shipboard fighter designed for the US Navy's 59,000-ton 'Forrestal' (CVA 59) class of carriers, land-based US Marines very nearly drew blood from Fidel Castro's MiG-17 fighter force. The first real action for the McDonnell F-4B Phantom II took place just after the Cuban missile crisis of October 1962 when the 'Gray Ghosts' of squadron VMFA-531 were rushed to NAS Key West, Florida, for 'hot pad alert' 154 km (96 miles) from Cuba. Squadron commander Colonel Robert Foxworth recalls: 'The Phantom was new. The MiG-17s out in those troubled waters between Florida and Cuba seemed to be flown by very good men, perhaps some Russians among them. They had something we didn't – cannons, for close-quarters fighting. During one mission we came within half a mile of each other and spent twenty minutes clawing for position, aware that their fighter was potent and ours was unproven. We never actually did battle with the Cubans but at the time it felt like the "real thing".'

Robert C. Little, now Vice-President at McDonnell and once chief test pilot, visited Farnborough in 1984 and reminisced wistfully about his first flight in the first Phantom, designed from the outset to bring new combat capability to aircraft-carrier decks. On 27 May 1958, when Bob Little went aloft in the F4H-1 Phantom prototype (142259), 'Not much of anything went right.' On his initial flight, Little was able neither to raise the landing gear fully nor to exceed the speed of sound. It was an inauspicious beginning for a fighter which, to make matters worse, did not look right. But by the outset of the 1960s, Phantom carrier trials were proceeding, more than 20 airframes were flying, and orders would eventually total 47 F-4As powered by an early General Electric J79 engine and 651 F-4Bs which employed the J79-GE-8 yielding 4944-kg (10,900-lb) thrust on military power and 7711-kg (17,000-lb) thrust with afterburning.

The Phantom was not merely new, it was different. It had two men, pilot and radar intercept officer (RIO). It had bent wings and a drooped tailplane. It was armed with missiles, not guns. With a tailhook and catapult-launch hardpoints, the Phantom was clearly a carrier aircraft yet sacrificed nothing in speed, ordnance load or manoeuvre capability when compared with less sturdy, landbased fighters. By the time Commander Paul Spencer, commander of the 'Be-devilers' of Squadron VF-74 on the Atlantic coast, became the first man to make 100 carrier-deck 'traps' in the F-4B in mid-1962, it was clear that early vicissitudes were behind and the Phantom would have a long career prowling the world's oceans from ship decks.

In August 1964, F-4Bs were catapulted from the USS *Constellation* (CVA 64) to fly top cover for the Gulf of Tonkin air strikes, President Lyndon Johnson's ad hoc retaliation against North Vietnam for torpedo-boat attacks on US vessels. In April 1965, sustained air action over North Vietnam began. On 17 June 1965, Commander Louis Page and Lieutenant John C. Smith Jr of the 'Freelancers' of Squadron VF-21 on the USS *Midway* (CVA 41), flying an F-4B (151488) used a Sparrow missile to shoot down a MiG-17 near Hanoi. This was the first of 41 MiG kills by carrierborne Phantoms, compared with only six losses in air-to-air battle.



***VMFA-333 F-4J on the cat. The Marines flew Phantoms from carriers throughout the Vietnam war, as well as from their main bases at Chu Lai and Da Nang. This continued through the 1970s when this aircraft was photographed on USS* Nimitz.**

Carrier-based Phantom variants

After the F-4A and F-4B models, 12 production F-4B airframes were completed as the F-4G variant. The F-4B had first flown on 25

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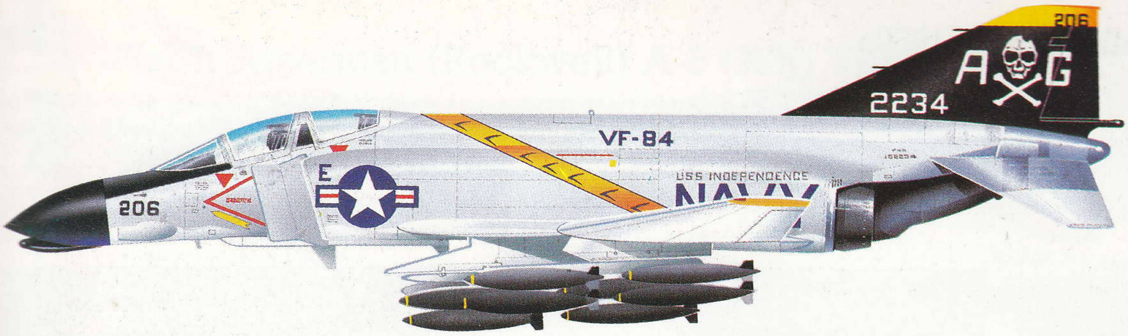
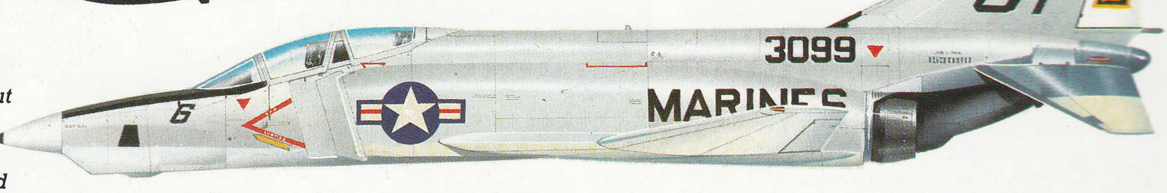
US Navy Phantoms have carried colourful paint schemes throughout their career, and these three from VF-154 based on USS* Ranger *are no exception. The Phantom now serves only on the USS* Midway*; all other carrier fighter squadrons now fly the Grumman F-14 Tomcat.



As well as its air-to-air role, the F-4 also flew many strike missions over Vietnam where its attributes of speed, load-carrying and accuracy made it an excellent ground-attack aircraft.

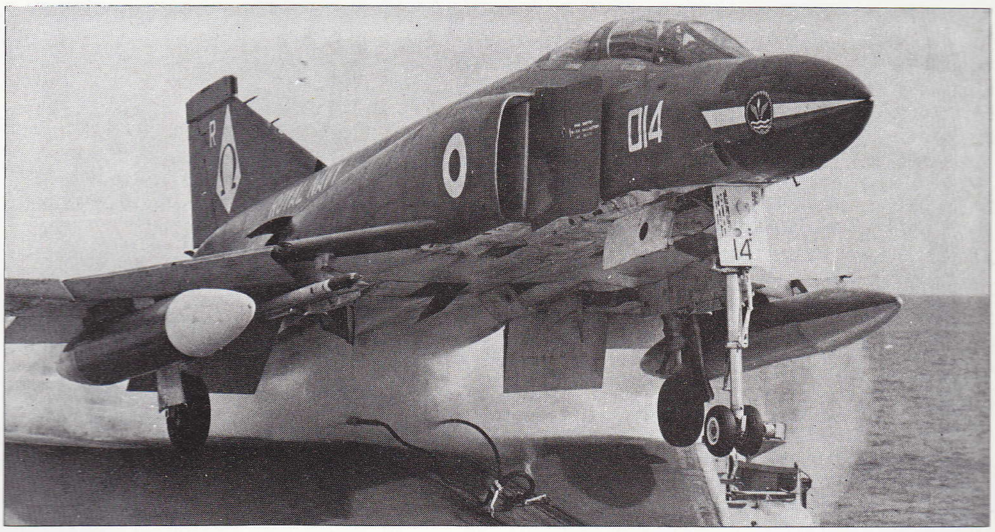


Marines units flew their RF-4B reconnaissance platforms from the decks of US Navy carriers throughout the conflict. The RF-4B carried both black-and-white and infra-red cameras, and provided a valuable back-up to the Navy's own RA-5s and RF-8s.

March 1961 and the F-4G followed on 20 March 1963. F-4Gs were fitted with the AN/ASW-21 digital data-link system which permitted automated carrier landings. They were flown in combat by the 'Black Lions' of Squadron VF-213 aboard the USS *Kitty Hawk* (CVA 63) reverting eventually to F-4B configuration more than a decade before the F-4G designation was reused by the US Air Force.

The RF-4B reconnaissance Phantom, first flown 12 March 1965 and built solely for the US Marine Corps, has operated from carrier decks until recently; 46 were delivered, some being still in service at MCAS El Toro.

The definitive naval Phantom was the F-4J, designed with higher landing weight and lower approach speed for more effective carrier operations. First flown on 27 May 1966, the F-4J also introduced drooped ailerons and slotted stabilator, retained the F-4G model's AN/ASW-21 data-link system, and had upgraded weapon and electronics systems. The F-4J (like late US Marine RF-4Bs) had bigger brakes and bigger mainwheel tyres. The F-4J was powered by two J79-GE-19 engines providing 8119-kg (17,900-lb) thrust with afterburning; 522 F-4Js were built and a few were in action in time to participate in the 'Rolling Thunder' campaign against North Vietnam which terminated with a bombing halt in October 1968.

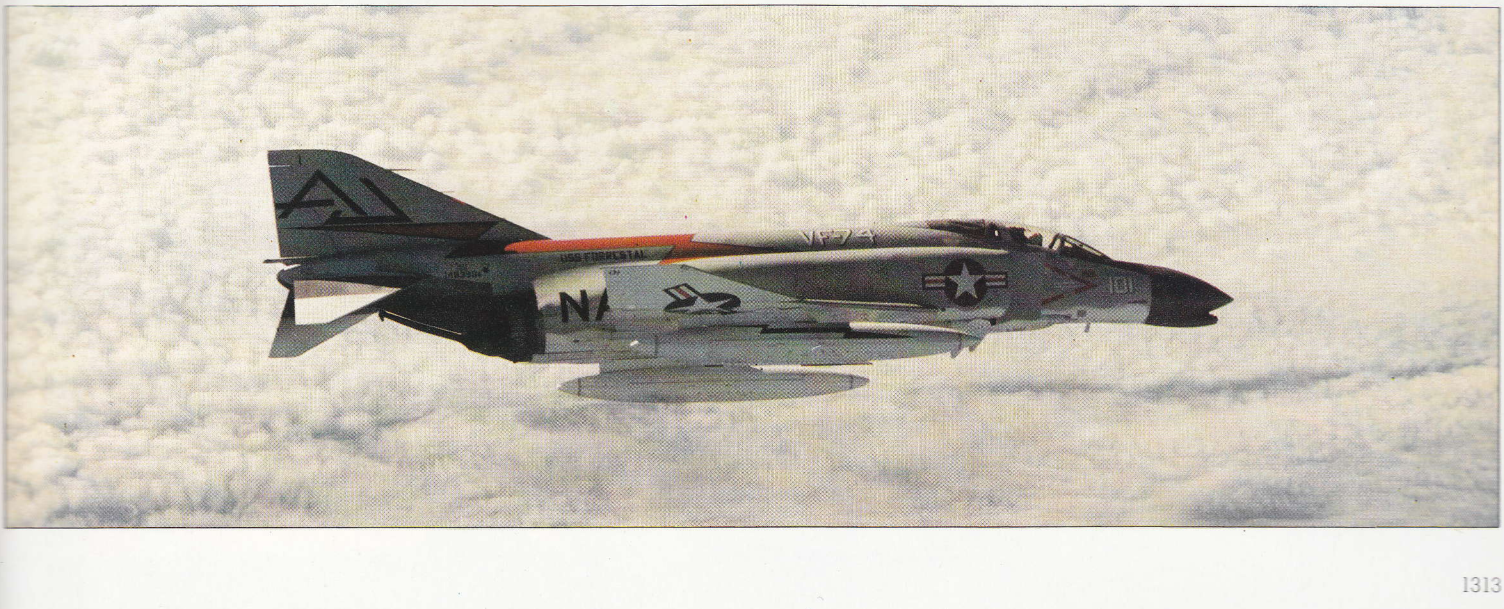


The only other naval operator of the Phantom was Britain, which operated F-4K models with Rolls-Royce Spey engines and extended nosewheel legs. This example is from No. 892 Sqn, launching from HMS Ark Royal. *ECM gear was added to the top of the fin.*

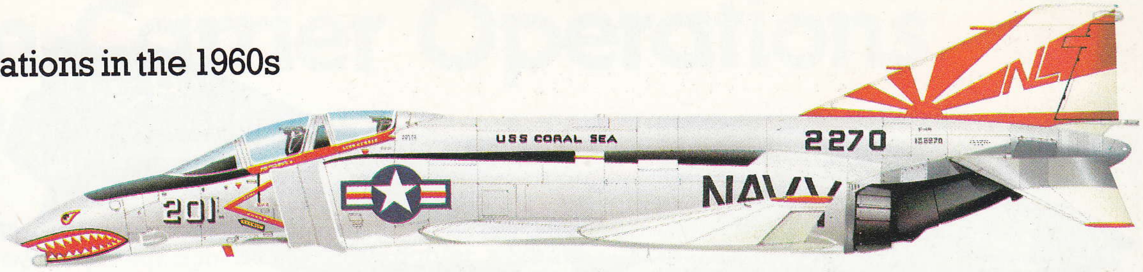
The F-4K was the Royal Navy's shipboard Phantom, first flown in June 1966. Powered by Rolls-Royce Spey 202/203 engines giving 9072-kg (20,000-lb) thrust with afterburning and equipped with raised nose gear and AWG-11 fire-control system, the F-4K put to sea aboard the carrier HMS *Ark Royal*. Two YF-4K service test craft were followed by 52 production machines, of which 24 went to the Royal Navy for shipboard operations.

Some 228 US Navy F-4B airframes were converted under a service life extension programme (SLEP) to F-4N standard with improved structure and updated equipment items such as the helmet-sight Visual Target Acquisition System (VTAS). A total of 248 F-4J aircraft (of 302 once scheduled) have been converted to F-4S configuration with manoeuvre slats, smokeless engines and improved systems.

Sneered at by F-8 pilots on account of its lack of cannon armament, size and all-round ugliness, the F-4 was soon to prove that size and beauty had little to do with success in air combat if you had powerful enough engines, and a sound airframe.



Phantom Carrier Operations in the 1960s



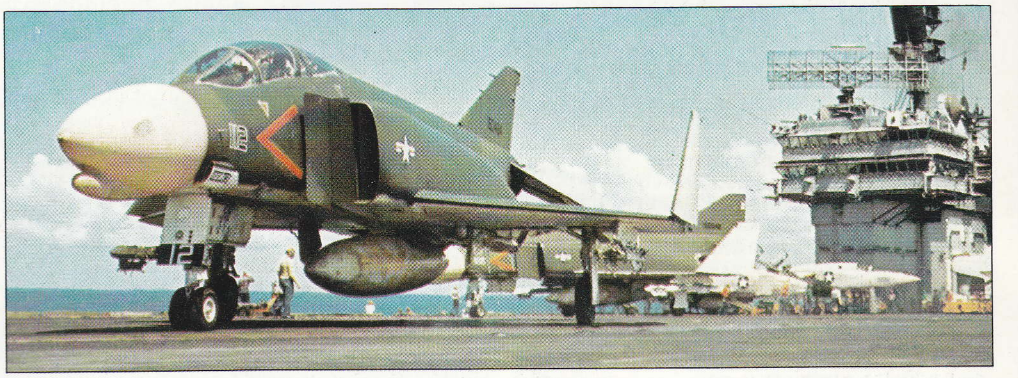
One of the most famous colour schemes ever carried by a Phantom was that applied by Fighting 111 'Sundowners' whilst flying both fighter-cover and ground attack missions from USS Coral Sea *during the later years in Vietnam.*

Phantom fighting tools

Conceived as an interceptor, the carrier Phantom proved an awesome fighter-bomber as well. But the F-4 will best be remembered for air battles over North Vietnam. By 1960s measure, the Phantom was 'one up' because of its superb radar which often could detect an enemy unseen. In air-to-air combat the principal punch of the Phantom was the AIM-7 Sparrow semi-active radar homing (SARH) air-to-air missile. The Sparrow was 3.66 m (12 ft) long and had a launch weight of 181 kg (400 lb), carrying a 27.2-kg (60-lb) high explosive warhead to an accurate range of up to 22 km (14 miles). It was the most effective possible weapon when a MiG pilot did not know it was coming and the attacking Phantom crew faced no risk of losing its radar 'lock on'.

Also arming the Phantom was the AIM-9 Sidewinder infra-red (IR) homing air-to-air missile. The AIM-9E model in use in 1965 was 2.87 m (9 ft) long, with a launch weight of 72.5 kg (160 lb), which carried a 4.54-kg (10-lb) HE warhead over a 3.7-km (2.3-mile) range. Initially tested with six Sparrows, carrier-based Phantoms usually carried four Sparrows and four Sidewinders. Over North Vietnam, this weapons mix proved effective against MiG-17s, MiG-19s and MiG-21s.

A world-class fighter in the 1960s, the Phantom has become outclassed in a more modern world. Says a US Navy reservist who flies the F-4S: 'I'm tired of going out to Red Flag (air combat training in Nevada) and getting zapped by an F-15 or F-16 before I ever see him.' The final combat for carrier Phantoms came during Operation 'Frequent Wind', the evacuation of Saigon in April 1975, an occasion which also marked first combat for the fighter destined to replace the Phantom on ships' decks, the Grumman F-14 Tomcat. Today, the world's only remaining carrier-based Phantoms are two squadrons of F-4Ss aboard the Japanese-based USS *Midway*.

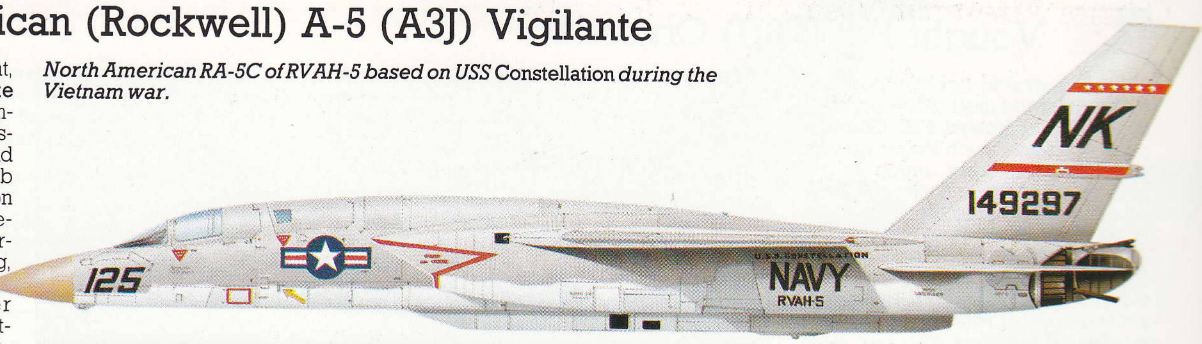


Not to be confused with the present US Air Force F-4G 'Wild Weasel' version, several F-4Bs were converted to F-4Gs with an automatic carrier-landing system for night operations. These appeared with VF-213 aboard USS* Kitty Hawk *with an experimental green camouflage.

Late evening in the Gulf of Tonkin; deck and aircrew have a few moments to savour the beauty of the South China Sea, to reflect on the day's missions and to plan those of the next day. At the heart of many of these missions was the legendary Phantom.

USA

North American (Rockwell) A-5 (A3J) Vigilante



North American RA-5C of RVAH-5 based on USS Constellation *during the Vietnam war.*

Though it never made the limelight, the **North American A3J Vigilante** probably introduced more design innovations than any other aircraft in history, including fully variable inlets and nozzles, a one-piece moving fin, slab tailerons used for roll in conjunction with roll-control spoilers, variable-camber blown wings, complete inertial navigation with autopilot coupling, automatic bad-weather carrier approach, drogue-stabilized rocket-augmented seats, and extensive titanium structure with gold coating in high-temperature areas. The prototype was a tandem-seat carrier-based bomber flown in August 1958. Yet another advanced feature was the large tunnel between the engines along the centreline. This housed two large fuel tanks and a nuclear weapon, all joined together and released as one unit over the target (the tanks then being empty and stabilizing the fall of the bomb); the assembly was ejected to the rear by gas pressure.

By early 1962 the first combat unit, VAH-7, was operating from USS *Enterprise*, the original **A3J-1** designation becoming **A-5A**. NAA delivered 57, followed by six **A-5B** aircraft with a giant humped fuselage housing extra fuel, and with still further high-lift wing systems. By far the most important model was the **RA-5C** long-range multi-sensor reconnaissance platform, which formed the airborne part of the US Navy Integrated Operational Intelligence System with automatic real-time information processing on the carrier or at a shore base. The RA-5C replaced the bomb tunnel by extra fuel, and a giant SLAR (side-looking airborne radar) was housed in a fairing along the belly. An impressive array of cameras and Elint (electronic intelligence) sensors made up the most comprehensive reconnaissance system of its day. NAA delivered 55 RA-5Cs, plus 59 converted from previous models. RVAH-5 equipped with this fine aircraft in June 1964, operating from the USS *Ranger* in South East Asia. Not until 1980 did the Vigilante begin to be replaced by the F-14 with a TARPS reconnaissance pallet.

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USS ENTERPRISE
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The attack version of the Vigilante was the A3J-1 (A-5A after 1962) which featured a tunnel bomb-bay between the two engines. The bomb was released backwards during a climb over the target. This proved slightly dangerous in practice as leaking fuel in the tunnel often ignited.

Specification

North American RA-5C Vigilante

Type: two-seat multi-sensor reconnaissance aircraft

Powerplant: two 7711-kg (17,000-lb) afterburning thrust General Electric J79-8A/8B turbojets

Performance: maximum speed, clean at high altitude 2229 km/h (1,385 mph); range 4828 km (3,000 miles); service ceiling 19505 m (64,000 ft)

Weights: empty 17009 kg (37,498 lb); maximum take-off 36100 kg (79,588 lb)

Dimensions: span 16.15 m (53 ft 0 in); length 23.32 m (76 ft 6 in); height 5.91 m (19 ft 4.8 in); wing area 70.0 m^2 (754 sq ft)

Armament: none

The most important version of the Vigilante was the RA-5C. Its main sensor was an enormous side-looking airborne radar (SLAR) mounted under the fuselage along with other cameras. RA-5s were usually escorted by F-4s over Vietnam to protect them from MiGs.

GM
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NAVY
RVAH-9
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USA

Vought F-8 (F8U) Crusader

It is a remarkable fact that, powered by the near-identical J57 engine, the carrier-based **Vought F8U Crusader** came out faster, much longer-ranged, more manoeuvrable, much slower landing and in almost every other way superior to the famed North American F-100 Super Sabre, even though it had all the penalties of carrier operation! By the 1960s it was distinctly long in the tooth and being replaced by the F-4, yet in Vietnam it not only gained more air-combat victories than any other type but was so popular it was commonly said that 'When you're out of F-8s, you're out of fighters'.

The requirement was issued in September 1952, calling for a supersonic air-superiority fighter. The most unusual feature was that the wing was placed above the fuselage and hinged so that, by varying its angle of incidence, the fuselage could be tilted nose-down to give the pilot a perfect forward view on the approach to the carrier. This also enabled the landing gears to be short, folding into the belly of the fuselage which also carried a giant door-type airbrake which, in turn, mounted the large tray of unguided air-to-air rockets forming the main armament. Four cannon were also installed, in the sides of the nose beside the engine air duct. The slab tailplane was mounted low, and another advanced feature was that the entire wing inboard of the fold axis on each side formed an integral tank.

The **XF8U-1** prototype flew on 25 March 1955, and after most rapid development the first US Navy squadron, VF-32, completed conversion in March 1957. Their **F8U-1** aircraft (later restyled **F-8A**) had a Martin-Baker F5 seat, neat folding inflight-refuelling probe in the left side of the fuselage and launch rails for Sidewinder on each side of the fuselage. Vought built 318 of this model before following with 130 **F-8B** aircraft with radar, 187 of an upgraded all-weather model, the **F-8C**, 152 of the **F-8D** with more power (fastest version, at Mach 1.86 or 1975 km/h/1,227 mph) and new avionics, and 286 **F-8E** multi-role attack machines with new radar, an IR seeker and various external weapons. The final 42 were **F-8E(FN)** fighters for the French Aéronavale with French R530 missiles and modified high-lift wing to suit small flight decks. By 1970 a total of 446 US Navy and US Marine F-8s had been completely rebuilt into new versions (**F-8H** to **F-8M**). Many of the unarmed **RF-8A** photo aircraft were rebuilt as **RF-8G** platforms, and these were the last to remain in US service.

Four F8U-2NE (F-8E) Crusaders of VF-51 break for the camera. The Crusader was universally loved by its pilots on account of its excellent agility and hard-hitting cannons. Vietnam combat proved that it more than equalled the pilots' views.

Specification

Vought F-8E Crusader

Type: single-seat carrier-based attack fighter

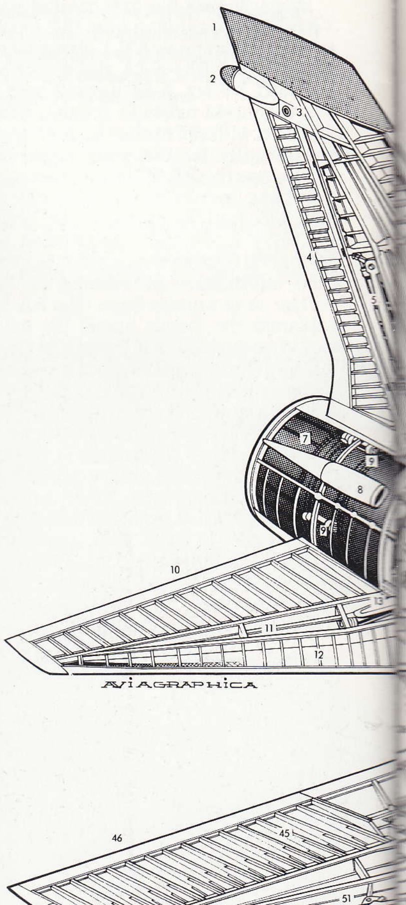
Powerplant: one 8165-kg (18,000-lb) afterburning thrust Pratt & Whitney J57-20A or -420 turbojet

Performance: maximum speed 1859 km/h (1,155 mph); range 2253 km (1,400 miles)

Weights: empty 8935 kg (19,700 lb); maximum take-off 15422 kg (34,000 lb)

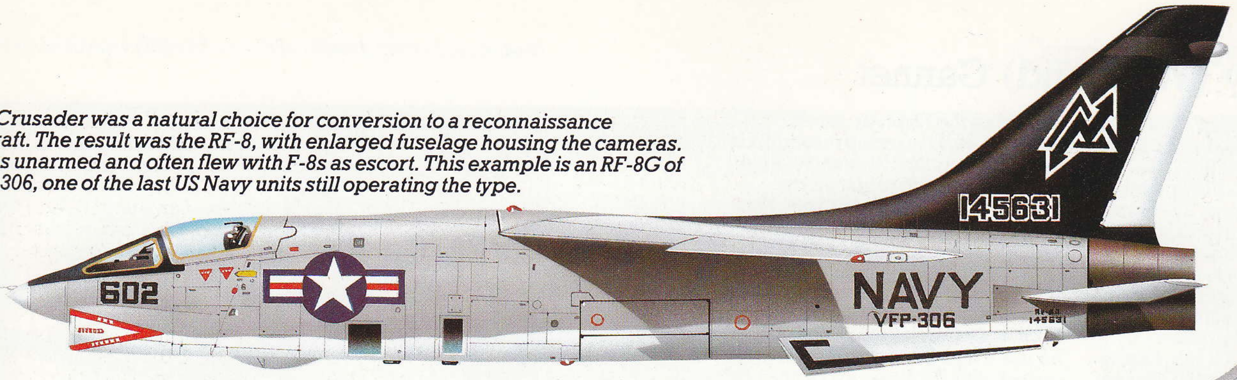
Dimensions: span 10.72 m (35 ft 2 in); length 16.61 m (54 ft 6 in); height 4.8 m (15 ft 9 in); wing area 34.84 m² (375 sq ft)

Armament: four 20-mm Mk 12 cannon each with 84 or 125 rounds and two/ four Sidewinder AAMs, plus up to 1814 kg (4,000 lb) of bombs, rockets or Bullpup missiles on four wing pylons

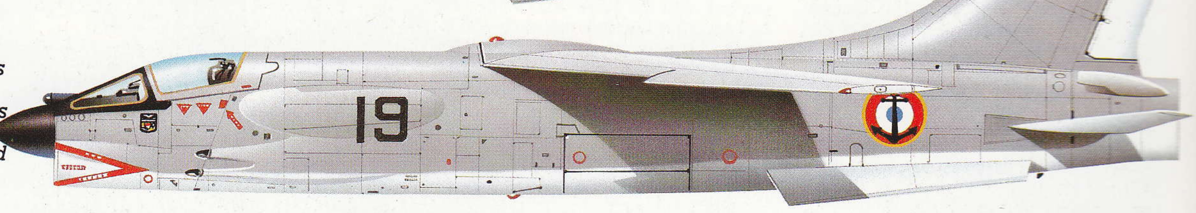


The variable-incidence wing was an ingenious answer to the problem of excessive angle of attack during landing and take-off, which severely restricted pilot vision. The principle worked well on the Crusader and no major problems were ever uncovered.

The Crusader was a natural choice for conversion to a reconnaissance aircraft. The result was the RF-8, with enlarged fuselage housing the cameras. It was unarmed and often flew with F-8s as escort. This example is an RF-8G of VFP-306, one of the last US Navy units still operating the type.

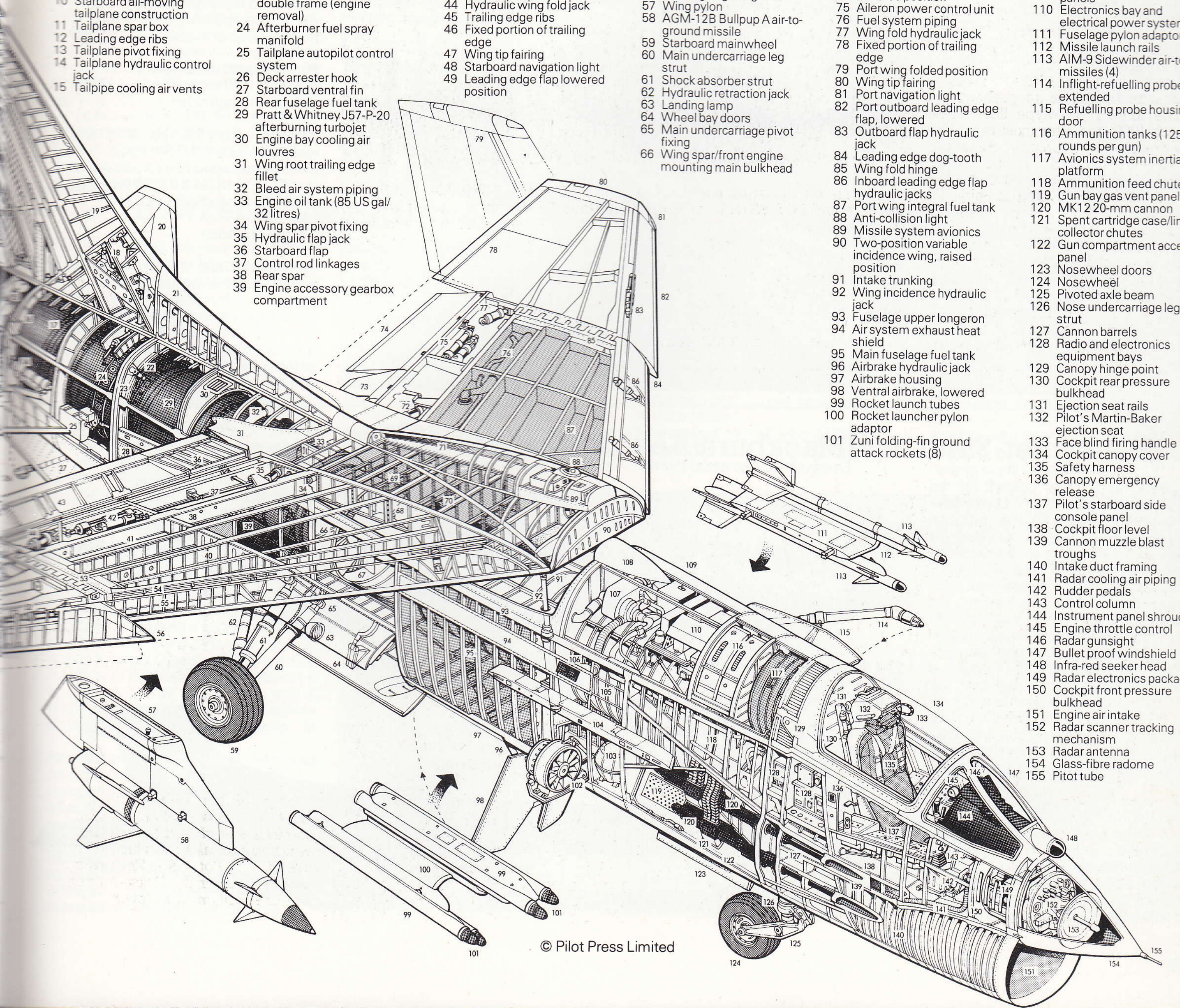


The other naval operator of the F-8 is the French Aéronavale, which operates F-8E(FN)s from the carriers Clemenceau and Foch. These are configured to carry Matra Magic and Matra 530 missiles.



Vought F-8E Crusader cutaway drawing key

1 Fin tip VHF aerial fairing
2 Tail warning radar
3 Tail navigation light
4 Rudder construction
5 Rudder hydraulic jack
6 Engine exhaust nozzle
7 Variable area nozzle flaps
8 Afterburner cooling air duct
9 Nozzle control jacks
10 Starboard all-moving tailplane construction
11 Tailplane spar box
12 Leading edge ribs
13 Tailplane pivot fixing
14 Tailplane hydraulic control jack
15 Tailpipe cooling air vents
16 Fin attachment main frame
17 Afterburner duct
18 Rudder control linkages
19 Fin leading edge construction
20 Port all-moving tailplane
21 Fin root fillet construction
22 Rear engine mounting
23 Fuselage break point double frame (engine removal)
24 Afterburner fuel spray manifold
25 Tailplane autopilot control system
26 Deck arrester hook
27 Starboard ventral fin
28 Rear fuselage fuel tank
29 Pratt & Whitney J57-P-20 afterburning turbojet
30 Engine bay cooling air louvres
31 Wing root trailing edge fillet
32 Bleed air system piping
33 Engine oil tank (85 US gal/32 litres)
34 Wing spar pivot fixing
35 Hydraulic flap jack
36 Starboard flap
37 Control rod linkages
38 Rear spar
39 Engine accessory gearbox compartment
40 Inboard wing panel multi-spar construction
41 Starboard wing integral fuel tank, total fuel system capacity 1,348 US gal (5103 litres)
42 Aileron power control unit
43 Starboard drooping aileron construction
44 Hydraulic wing fold jack
45 Trailing edge ribs
46 Fixed portion of trailing edge
47 Wing tip fairing
48 Starboard navigation light
49 Leading edge flap lowered position
50 Leading edge flap rib construction
51 Outer wing panel spar construction
52 Leading edge flap hydraulic jack
53 Wing fold hinge
54 Front spar
55 Leading edge flap inboard section
56 Leading edge dog-tooth
57 Wing pylon
58 AGM-12B Bullpup A air-to-ground missile
59 Starboard mainwheel
60 Main undercarriage leg strut
61 Shock absorber strut
62 Hydraulic retraction jack
63 Landing lamp
64 Wheel bay doors
65 Main undercarriage pivot fixing
66 Wing spar/front engine mounting main bulkhead
67 Engine compressor intake
68 Wing root rib
69 Centre section fuel tank
70 Wing spar carry-through structure
71 Dorsal fairing
72 Port flap jack
73 Port plain flap, lowered position
74 Port drooped aileron, lowered position
75 Aileron power control unit
76 Fuel system piping
77 Wing fold hydraulic jack
78 Fixed portion of trailing edge
79 Port wing folded position
80 Wing tip fairing
81 Port navigation light
82 Port outboard leading edge flap, lowered
83 Outboard flap hydraulic jack
84 Leading edge dog-tooth
85 Wing fold hinge
86 Inboard leading edge flap hydraulic jacks
87 Port wing integral fuel tank
88 Anti-collision light
89 Missile system avionics
90 Two-position variable incidence wing, raised position
91 Intake trunking
92 Wing incidence hydraulic jack
93 Fuselage upper longeron
94 Air system exhaust heat shield
95 Main fuselage fuel tank
96 Airbrake hydraulic jack
97 Airbrake housing
98 Ventral airbrake, lowered
99 Rocket launch tubes
100 Rocket launcher pylon adaptor
101 Zuni folding-fin ground attack rockets (8)
102 Emergency air driven generator, extended position
103 Liquid oxygen bottle (LOX)
104 Fuselage stores pylon
105 Intake duct
106 Heat exchanger air exhaust
107 Air conditioning plant
108 Dorsal fairing
109 Upper fuselage access panels
110 Electronics bay and electrical power system
111 Fuselage pylon adaptor
112 Missile launch rails
113 AIM-9 Sidewinder air-to-air missiles (4)
114 Inflight-refuelling probe extended
115 Refuelling probe housing door
116 Ammunition tanks (125-rounds per gun)
117 Avionics system inertial platform
118 Ammunition feed chutes
119 Gun bay gas vent panel
120 MK12 20-mm cannon
121 Spent cartridge case/link collector chutes
122 Gun compartment access panel
123 Nosewheel doors
124 Nosewheel
125 Pivoted axle beam
126 Nose undercarriage leg strut
127 Cannon barrels
128 Radio and electronics equipment bays
129 Canopy hinge point
130 Cockpit rear pressure bulkhead
131 Ejection seat rails
132 Pilot's Martin-Baker ejection seat
133 Face blind firing handle
134 Cockpit canopy cover
135 Safety harness
136 Canopy emergency release
137 Pilot's starboard side console panel
138 Cockpit floor level
139 Cannon muzzle blast troughs
140 Intake duct framing
141 Radar cooling air piping
142 Rudder pedals
143 Control column
144 Instrument panel shroud
145 Engine throttle control
146 Radar gunsight
147 Bullet proof windshield
148 Infra-red seeker head
149 Radar electronics package
150 Cockpit front pressure bulkhead
151 Engine air intake
152 Radar scanner tracking mechanism
153 Radar antenna
154 Glass-fibre radome
155 Pitot tube



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UK

Fairey (Westland) Gannet

Providing the Fleet Air Arm's airborne early warning throughout the 1960s was the Westland Gannet AEW.Mk 3, which replaced the Douglas Skyraider in this role. This aircraft served on board HMS Ark Royal with No. 849 Sqn.

Unique in many ways, this distinctive machine began life as the **Fairey GR.17** (from the specification, GR.17/45), the first prototype flying on 19 September 1949. It was designed as an ASW (anti-submarine warfare) hunter-killer able to operate from small carriers yet carry radar and sonobuoys to detect submarines, as well as weapons in an internal bay to kill such submarines as were found. Delay was caused by a sudden decision to add a third crew-member, but eventually the **Gannet AS.Mk 1** entered service with No. 826 Squadron in January 1955.

Propulsion was provided by a turboprop with two independent power sections each driving one half of a double co-axial propeller. Thus, without affecting the handling, either half-engine and its propeller could be shut down in flight to extend mission endurance. Another advantage was that the engine could operate on ship's diesel oil. The large wing folded in four places to reduce span and height without interfering with access to the rear cockpits or the twin jetpipes, and other features included steerable twin-wheel nose gears, a very large weapon bay and a radar extended from below the rear fuselage. **Gannet AS.Mk 1, Gannet AS.Mk 4, Gannet AS.Mk 6** and **Gannet AS.Mk 7** aircraft served with the Royal and some other navies, surviving into the early 1960s in West Germany, Australia and Indonesia. The **Gannet T.Mk 2** and **Gannet T.Mk 5** were trainers.

Most important in the 1960s was the **Westland Gannet AEW.Mk 3**, the airborne early-warning version built to replace the Skyraider in the Royal Navy's No. 849 Squadron. Powered by an uprated engine, this had a new fuselage with no weapon bay, a single pilot cockpit at the front and a cabin for two radar observers aft of the wing, the tail also being enlarged to balance the big radome of the APS-20A radar, and the landing gear being lengthened. The last was delivered in 1961, and when the RN fixed-wing force was run down and 'B' Flight of No. 849 Squadron left HMS *Ark Royal* in 1978 the UK had no seaborne AEW capability, something bitterly regretted just four years later in the South Atlantic.

Specification

Westland Gannet AEW.Mk 3

Type: three-seat carrier-based AEW aircraft

Powerplant: one 3,875-hp (2890 kW) Bristol Siddeley (previously Armstrong Siddeley, later Rolls-Royce) Double Mamba 102 coupled turboprop

Performance: maximum speed 417 km/h (259 mph); range 1127 km (700 miles); patrol height 7770 m (25,500 ft)

Weights: empty 7421 kg (16,360 lb); maximum take-off 11340 kg (25,000 lb)

Dimensions: span 16.61 m (54 ft 6 in); length 13.41 m (44 ft 0 in); height 5.13 m (16 ft 10 in); wing area 44.9 m^2 (483 sq ft)

Armament: none

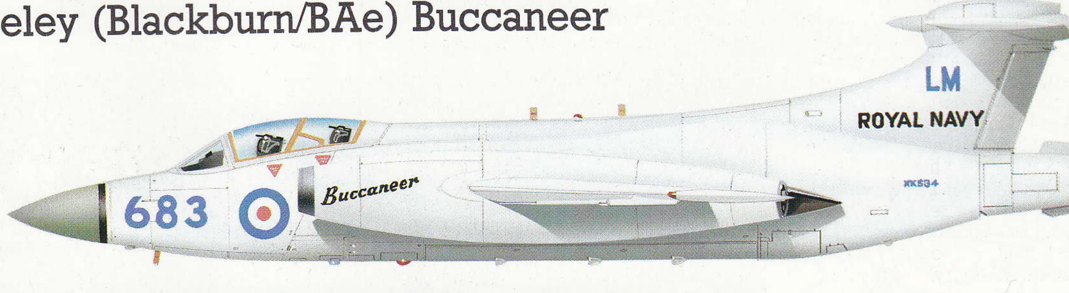
The Fairey Gannet was developed as an anti-submarine aircraft and served in this role for many years until superseded by the Westland Sea King helicopter. This example is a T.Mk 5 trainer. An unusual feature of the Gannet was the four-folding wing.

UK

Hawker Siddeley (Blackburn/BAe) Buccaneer

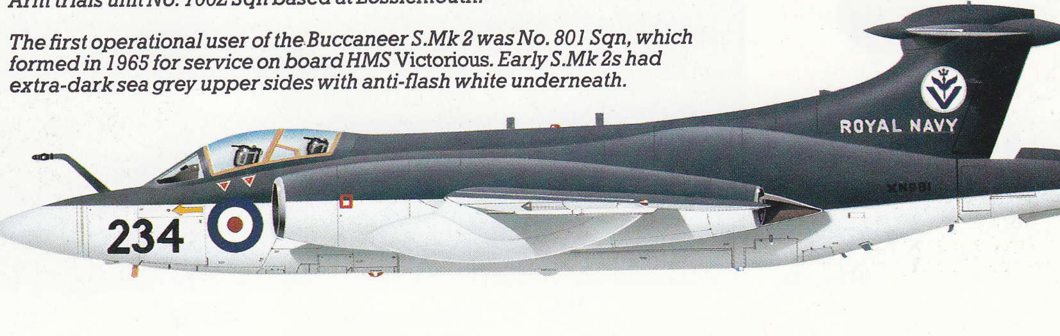
Designed as a strike aircraft for the Royal Navy, the **Hawker Siddeley Buccaneer** first flew in April 1958 and had a distinguished career in the Fleet Air Arm. Today it serves in the maritime strike role with RAF Nos 12 and 208 Squadrons based at Lossiemouth. Seating pilot and observer in tandem, the **Buccaneer S.Mk 2** is a large aircraft distinguished by its capacious internal bomb bay, whose rotary door incorporates a large fuel tank. With a load of 1814 kg (4,000 lb) inside the bay, this subsonic aircraft is faster than any supersonic aircraft with the same load hung externally, and its fuel consumption is very modest because the efficient fan engines have no afterburners.

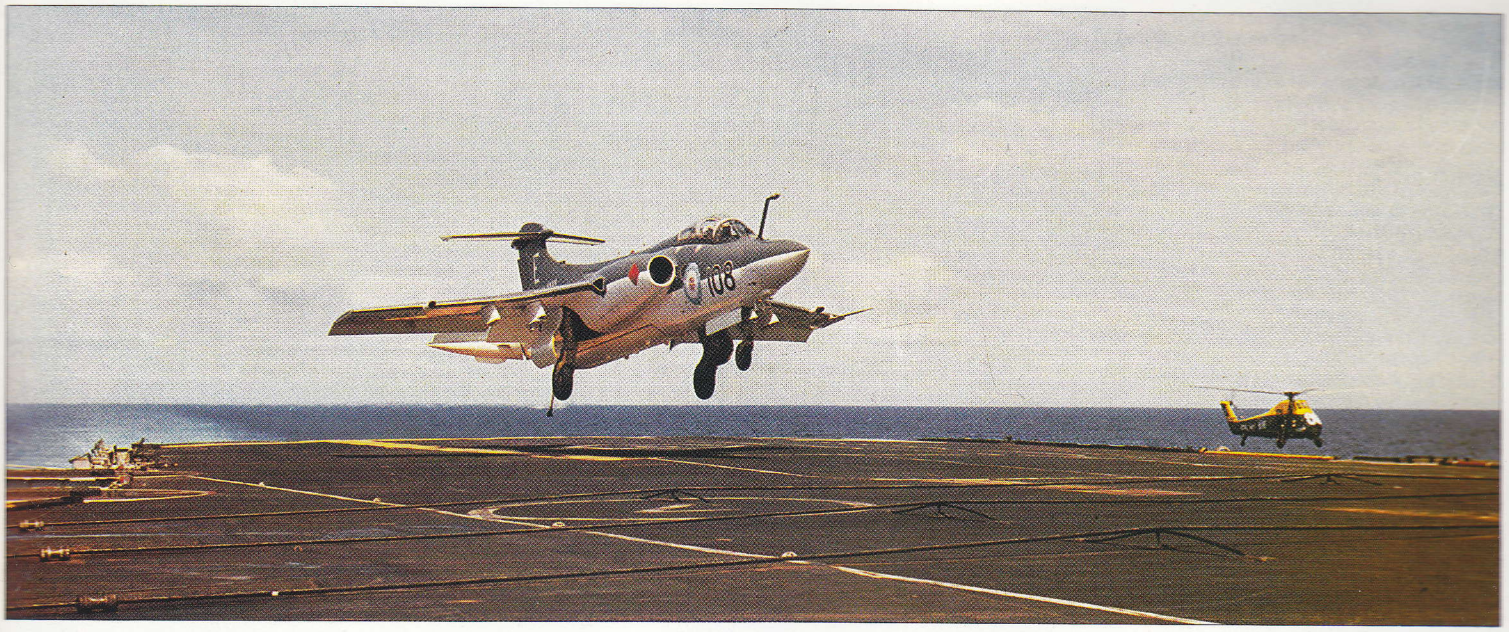
In recent years Sidewinders have been added for self-defence and the ECM fit has been greatly augmented, with further updates in the pipeline. Though a few aircraft were lost to the service because of structural problems in 1982, which necessitated a major anti-fatigue modification program-



The initial colour scheme for the Buccaneer was overall 'anti-flash' white, as carried by the 18th pre-production aircraft, bearing the marking of Fleet Air Arm trials unit No. 700Z Sqn based at Lossiemouth.

The first operational user of the Buccaneer S.Mk 2 was No. 801 Sqn, which formed in 1965 for service on board HMS Victorious. Early S.Mk 2s had extra-dark sea grey upper sides with anti-flash white underneath.





A Blackburn Buccaneer S.Mk 1 lands on HMS Eagle while a 'plane-guard' Wessex waits, ready to pick up any aircrew unfortunate enough to ditch. The Buccaneer S.Mk 1 was powered by two 3,220-kg (7,100-lb) DH Gyron Junior engines.

me, replacement by Panavia Tornados in some squadrons means there is no shortage of these extremely popular and capable long-range attack aircraft. Some might be converted for the electronic reconnaissance and jamming role. A refuelling probe can be attached above the nose but is seldom used.

Six **Buccaneer S.Mk 50** aircraft continue to serve with the South African air force, despite a long-term ban on support from the UK. These aircraft carry the AS.30 missile among other weapons, and have an inbuilt BS.605 rocket motor to boost hot/high take-offs.

Specification
Hawker Siddeley Buccaneer S.Mk 2B
Type: two-seat attack aircraft
Powerplant: two 5003-kg (11,030-lb) thrust Rolls-Royce Spey 101 turbofans
Performance: maximum speed, clean at sea level 1110 km/h (690 mph); range with internal bombs and maximum fuel on a hi-lo-hi mission 3701 km (2,300 miles)
Weights: empty 13608 kg (30,000 lb); maximum take-off 28123 kg (62,000 lb)
Dimensions: span 13.41 m (44 ft 0 in); length 19.33 m (63 ft 5 in); height 4.95 m (16 ft 3 in); wing area 47.82 m^2 (514.7 sq ft)
Armament: maximum bombload of 1814 kg (4,000 lb) in internal bay plus 5443 kg (12,000 lb) on four wing pylons; loads can include Sea Eagle, Martel, Harpoon, Shrike, Alarm and Sidewinder missiles

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UK

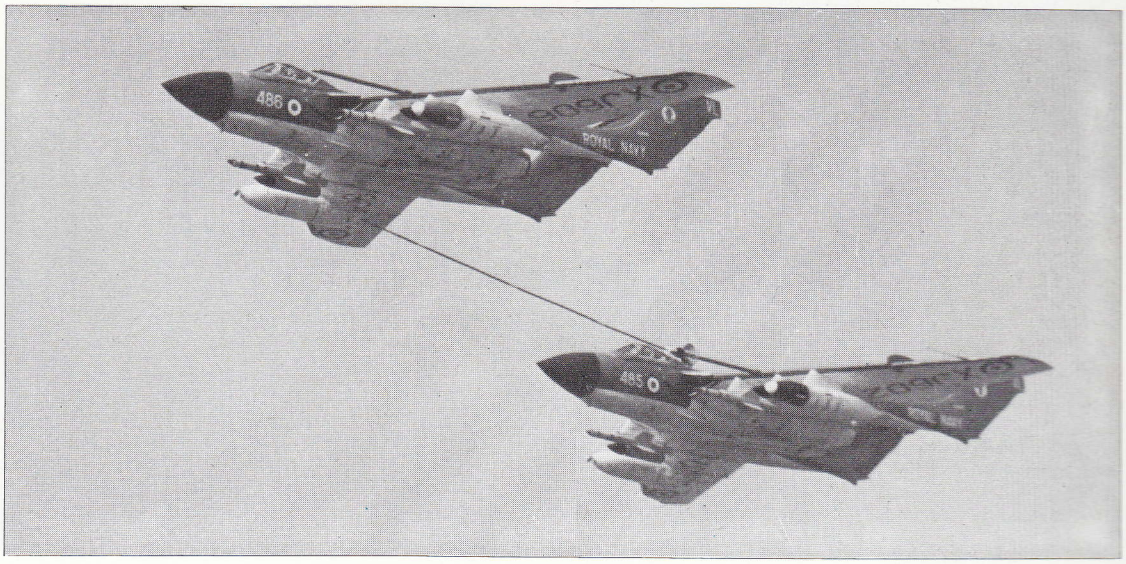
Hawker Siddeley (DH/BAe) Sea Vixen

This impressive two-seat all-weather interceptor began life in 1946 and might have been in service in 1951, but thanks to a succession of indecisions and a horrific crash of a prototype, the **de Havilland Sea Vixen** languished until the Royal Navy renewed interest in 1954. Eventually a fully navalized prototype flew in 1957 and the first **Sea Vixen FAW.Mk 1** squadron was commissioned on 2 July 1959.

Retaining the company's twin-boom layout, the Vixen was unique in seating the pilot high on the left, with the radar observer inside what was called 'the coal hole' low down on the right, with a roof hatch and small window. Immediately beside were the inlet ducts from the wing roots leading to the two turbojets in the rear of the nacelle. The nose was filled by the big GEC AI.Mk 18 radar. No guns were fitted, their place being occupied by two hinged packs each housing a battery of 14 air-to-air rockets. Wing pylons carried up to four Blue Jay (Firestreak) IR-homing AAMs, and the Vixen was also cleared to operate in the attack role with a wide range of bombs and air-to-surface missiles such as Bullpup. In practice these fine aircraft were used mainly as interceptors.

The 92nd aircraft was modified on the production line as the first **Sea Vixen FAW.Mk 2**, with swollen tail booms housing more fuel, and with a modified fire-control system compatible with the much more formidable Red Top AAM. As on the Mk 1 aircraft, an in-flight-refuelling probe could be attached in the wing leading edge outboard of the left boom, and there were additional avionic items. Total production of both marks was 148, many Mk 1s being converted after delivery to Mk 2 standard. After replacement by McDonnell Douglas Phantoms from 1970, many Sea Vixens were rebuilt as **Sea Vixen D.Mk 3** pilotless RPV targets.

Specification
de Havilland Sea Vixen FAW.Mk 2
Type: two-seat carrier-based all-weather fighter
Powerplant: two 5094-kg (11,230-lb) thrust Rolls-Royce Avon 208 turbojets
Performance: maximum speed 1110 km/h (690 mph) at sea level; range at high altitude on internal fuel 1931 km (1,200 miles); service ceiling 14630 m (48,000 ft)
Weights: empty 11793 kg (26,000 lb); maximum take-off 18858 kg (41,575 lb)
Dimensions: span 15.54 m (51 ft 0 in); length 16.94 m (55 ft 7 in); height 3.28 m (10 ft 9 in); wing area 60.2 m^2 (648 sq ft)
Armament: four Red Top AAMs and 28 Microcell 2-in (51-mm) rockets, plus provision for very varied offensive loads up to 1361 kg (3,000 lb) in weight on four or six wing pylons



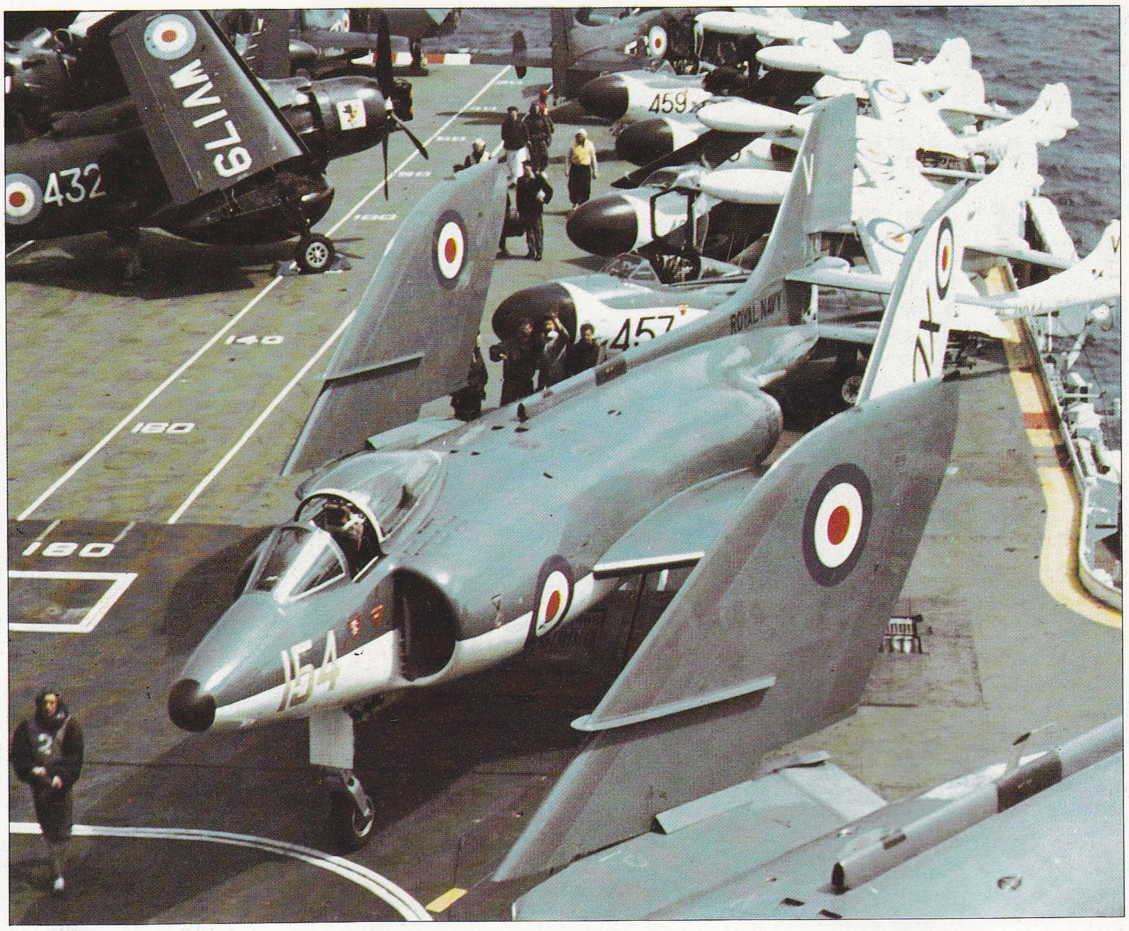
Part of the Sea Vixen's repertoire was buddy-buddy refuelling, here demonstrated by two FAW.Mk 1s from No. 899 Sqn. The missiles carried are de Havilland Firestreak infra-red homing. The FAW.Mk 2 featured enlarged tail booms which extended forward of the leading edge, and was equipped to fire the more advanced Red Top missile.

UK

Supermarine Scimitar

In the UK the process of introducing transonic swept-wing fighters into the Fleet Air Arm was painfully slow. Virtually nothing was done in the first five years after World War II; then, apparently unexpectedly, the carrier trials of the swept-wing Supermarine Type 510 in November 1950 showed that there need not be any problem. Even then it was to be almost another 10 years before anything reached the squadrons. Via the butterfly-tailed Supermarine Type 508 and Type 529 and all-swept Type 525 the halting progress led to the Type 544, or N.113D, of January 1956. This was fitted with 200-series Avons, large flaps intended to be blown from the engines, folding wings, perforated airbrakes on the rear fuselage and a slab tailplane. It led directly to the first of 76 **Supermarine Scimitar F.Mk 1** aircraft built in 1957-60.

A big and tough machine, the Scimitar had been planned as a carrier-based interceptor, though nobody thought of giving it any radar. By the mid-1950s it seemed that the need was for a low-level bomber and in service the Scimitar, though designated as a fighter, spent most of its brief life in vague attack roles. Its four wing pylons were each rated at 907 kg (2,000 lb), though no squadron machine ever carried external loads of weapons greater than 1814 kg (4,000 lb). Nuclear capability was announced, though the Fleet Air Arm did not possess such weapons. It was also announced that the Scimitars would carry 'missiles', but the only offensive type carried (very briefly, on trials) was the command-guidance Bullpup. There was never any proper air/surface weapon-aiming system, and the lone pilot in any case had his hands full trying to navigate at sea without any modern navaids. At least the squadron aircraft had a nose-mounted inflight-refuelling probe, and the Scimitar's last combat role was carrying a buddy pack to refuel Hawker Siddeley Buccaneers of No. 800 Squadron in 1965-6. With proper avionics these basically capable aircraft might have had long careers.



Seen with AEW Skyraiders and Sea Venoms, this Scimitar F.Mk 1 is being prepared for a mission. The Scimitar was never successful in its intended role and was retired in favour of the two-seat Buccaneer early in its expected life, as the extra crew member made life much easier.

Specification

Supermarine Scimitar F.Mk 1
Type: single-seat attack fighter
Powerplant: two 5103-kg (11,250-lb) thrust Rolls-Royce Avon 202 turbojets, with bleed for flap-blowing
Performance: maximum speed, clean at sea level 1143 km/h (710 mph); combat radius on a hi-lo-hi mission with internal fuel 579 km (360 miles); ferry range 3380 km (2,100 miles); service ceiling 14020 m (46,000 ft)
Weights: empty 11295 kg (24,900 lb); maximum take-off 18144 kg (40,000 lb)
Dimensions: span 11.33 m (37 ft 2 in); length (excluding probe) 16.87 m (55 ft 4 in); height 4.65 m (15 ft 3 in); wing area 45.0 m^2 (484.9 sq ft)
Armament: four 30-mm Aden cannon each with 100 rounds, plus four wing pylons each rated at 907 kg (2,000 lb) for Sidewinder AAMs, bombs, rocket pods, buddy packs or 909-litre (200-Imp gal) drop tanks

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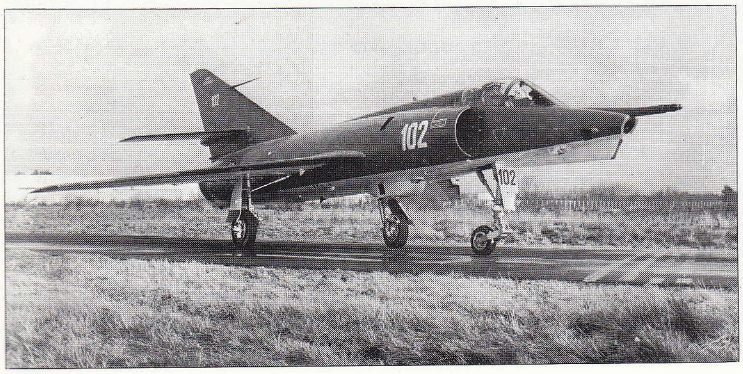
FRANCE

Dassault Etendard

Designed at the same time as the Mirage, in 1954-5, the **Dassault Etendard** was intended as a NATO light attack aircraft but eventually, in 1962, entered service with the French Aéronavale as a carrier-based attack aircraft **(Etendard IVM)** or photo-reconnaissance aircraft **(Etendard IVP)**. The engine selected, after flight testing various other arrangements of single and twin engines, was the Atar 8B, basically a Mirage III engine without the afterburner (because there was no requirement for supersonic performance). An extremely conventional aircraft, the Etendard seated its pilot in a Martin-Baker N4A seat, had long-stroke main gears, small flaps and ailerons all inboard of the wing fold (which folded only the tips) and a horizontal tail pivoted well up the large fin. The leading edges had a marked dogtooth inboard of hinged flaps depressed at low speeds for flight at high angles of attack.

A total of 69 Etendard IVM attack aircraft was delivered, equipping squadrons 11F and 17F and often operating from the carriers *Foch* or *Clemenceau*. A refuelling probe can be attached above the slim nose, which houses a small Aïda ranging radar (which has no search or bad-weather capability), and the only aid to weapon delivery is a Saab toss-bombing computer. The unique fin under the nose housed the guidance transmitter aerial for the Nord AS.20 or AS.30 missiles. The Etendard IVP replaces the radar by a fixed probe and the guns by five OMERA cameras. Another modification in the Etendard IVP is an independent navigation system. This model, of which 21 were ordered, equips squadron 16F, and has no visible replacement.



The Etendard has served with the French Aéronavale since 1962 as both a light strike aircraft and a photo-reconnaissance aircraft. The Etendard IVP carries out the latter function and carries cameras in a redesigned nose. These are still in service and there is no likely replacement yet.

Specification

Dassault Etendard IVM
Type: single-seat carrier-based attack aircraft
Powerplant: one 4400-kg (9,700-lb) thrust SNECMA Atar 8B turbojet
Performance: maximum speed, clean at sea level 1099 km/h (683 mph); tactical radius on a lo attack mission with maximum internal fuel 300 km (186 miles)
Weights: empty 6123 kg (13,500 lb); maximum take-off 10275 kg (22,650 lb)
Dimensions: span 9.60 m (31 ft 6 in); length 14.40 m (47 ft 3 in); height 4.30 m (14 ft 1.3 in); wing area 29.0 m^2 (312.2 sq ft)
Armament: two 30-mm DEFA cannon each with 100 rounds, plus four wing pylons for a maximum total load of 1361 kg (3,000 lb) of bombs or other stores including AS.30 attack missiles or Sidewinder self-defence AAMs

US Army

Part 5

Missiles and artillery

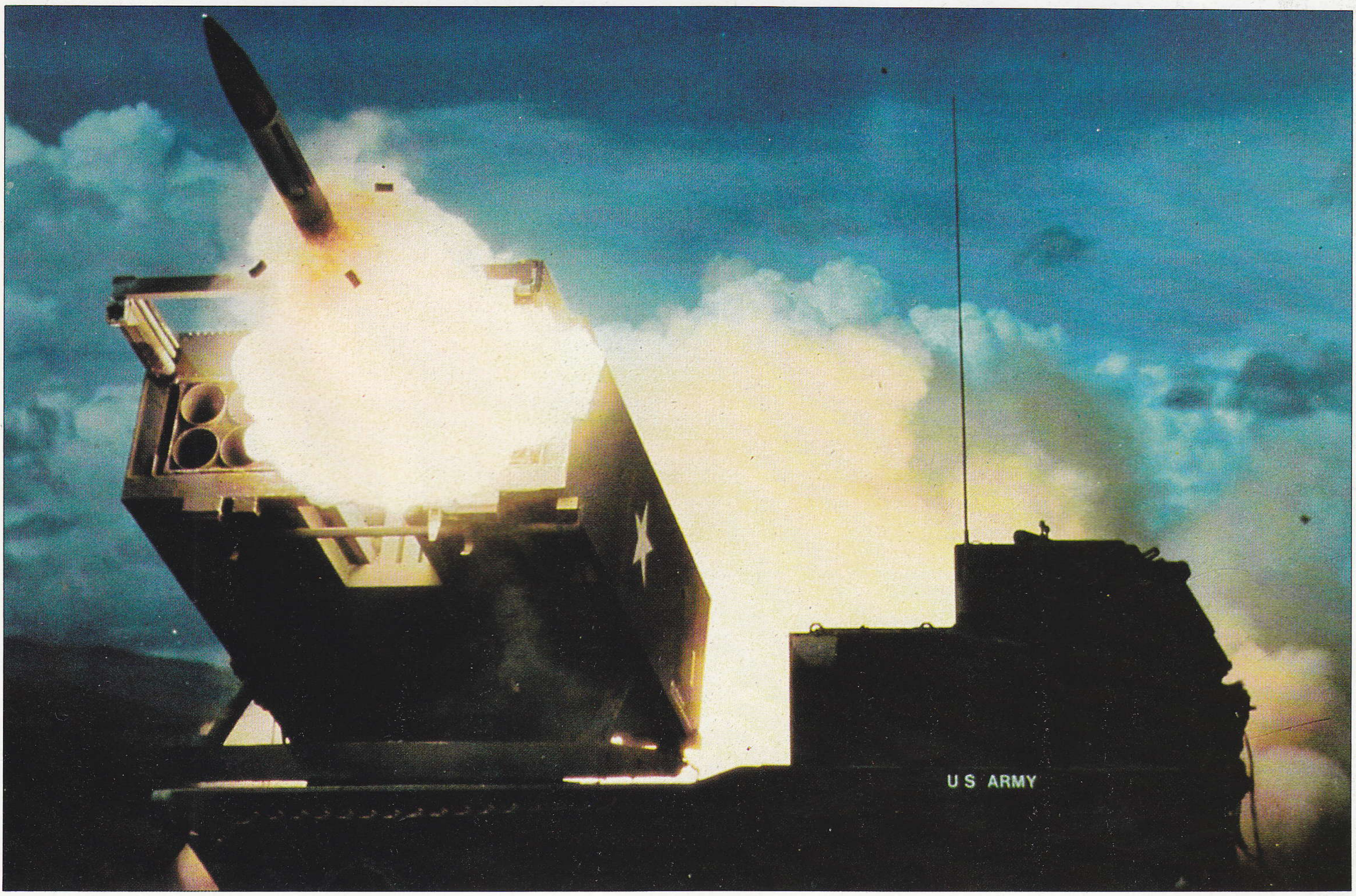
Most frightening of the US Army's weapons is the MGM-31A Pershing battlefield missile. This hefty ballistic missile uses inertial guidance to steer its nuclear warhead to a target up to 740 km (460 miles) distant. The Pershing can be towed and used direct from field sites with only a limited amount of preparations. Pershings already serve in Europe, and the US Army has four Pershing battalions, one a training formation capable of taking the field if required. Starting in 1984, it is scheduled that existing Pershings will be replaced by the Pershing 2 with terminal guidance for a superior but smaller warhead, and with improved range. The new model is the fear of peace demonstrators and a volatile new factor in the European equation, reducing to as little as 15 minutes the decision time available to Soviet policymakers when they think it is coming at them. The same ground support equipment as that for the existing Pershing will be used.

Only slightly less powerful than the Pershing is the MGM-52C Lance battlefield support missile. Like the Pershing, the Lance can be fitted with a nuclear warhead, but the US Army also fields large HE warheads for this missile. The range of the Lance is 120 km (75 miles), and the missile is carried on the battlefield by a special launch vehicle, yet another variation on the M113 APC. The Lance is currently being used as the base vehicle for a new generation of battlefield support missiles intended primarily for use against massed enemy armour. This·programme is known as Tank Breaker and already a special warhead containing a large number of anti-tank bomblets has been developed and issued. Lance is deployed in Europe with US and NATO units.

A rocket system yet to be deployed by the US Army is the Multiple Launch Rocket System (MLRS). MLRS is primarily an artillery rocket intended to saturate enemy targets with salvoes of unguided 227-mm (8.93-in) rounds. These are transported and issued in six-rocket pallets that also act as the launching frames, carried on the rear of armoured tracked vehicles. The launcher vehicles are equipped with some very advanced battlefield navigation and position-fixing electronics that enables the three-man crew to launch the rockets at targets 30000 m (32,800 yds) distant. Once the rockets have been launched, the vehicles reload from support vehicles close by. MLRS warheads for the initial batch will be fitted with West German AT-2 anti-tank mines. The first MLRS equipments have already been issued and the first battery has been activated.

In artillery, the US Army is now almost entirely equipped with self-propelled items for front-line formations. Largest in calibre is the 203-mm (8-in) M110 howitzer, which has a range of 21300 m (23,300 yds), and in its latest M110A2 form of 29100 m (31,825 yds) with enhanced-range projectiles. The M110 series can fire nuclear projectiles. The basic HE shell weighs no less than 92.5 kg (204 lb) and has tremendous destructive potential. The howitzer of the M110 is carried on a special tracked carriage and there is no protection for the gun crew, which consists of five men actually on the gun with more in support vehicles carrying ammunition. The basic M110 has now been replaced by the M110A1 with a longer barrel and by the M110A2 which has the longer barrel with a muzzle brake enabling it to fire more powerful propellant charges.

The most numerous of US Army self-propelled items is the series of vehicles based on the M109 155-mm (6.1-in) howitzers. The M109 has its howitzer in a 360° traversing turret mounted on a chassis that is fitted with armour manufactured from aluminium alloys. The vehicle is thus light for its bulk and is amphibious to a limited degree. The howitzer can fire an HE shell weighing 43 kg (95 lb) to a range of 18100 m (19,800 yds) in the M109A1 version, and the projectiles fired are all standard NATO items that can be acquired throughout the Treaty nations. The original M109 has now been



Vought Multiple Launch Rocket System (MLRS) launches a rocket during its early trial. By June 1984 over 100 of these systems had been built, and the first battery was operational with the 7th Army in West Germany. The system will also be fielded by four other NATO countries.

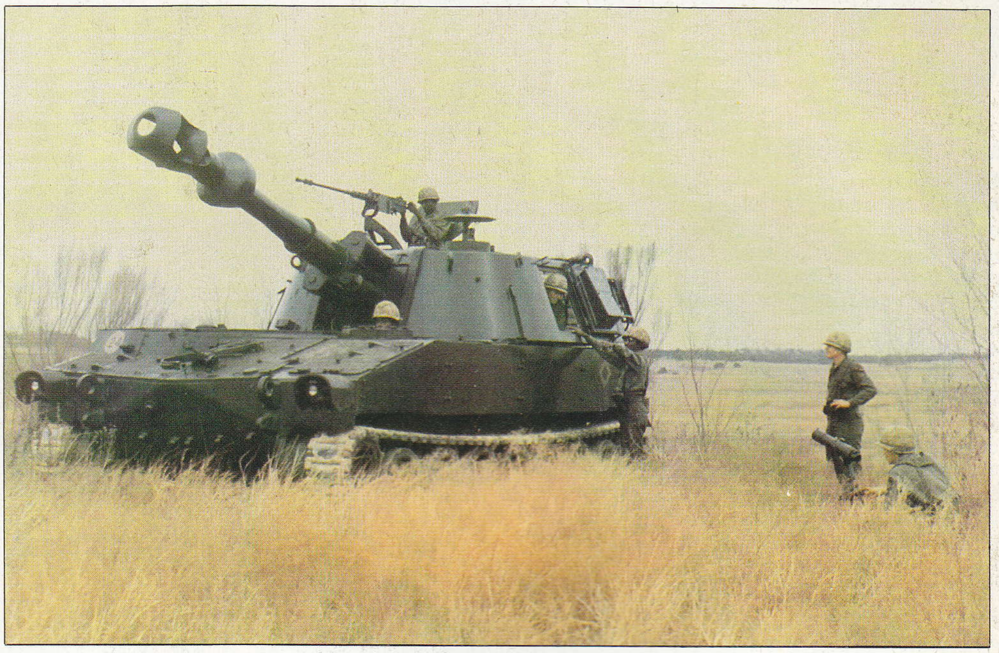
replaced by the M109A1 with a longer barrel to improve range, and the M109A2 is the full production version with the long barrel and other detail internal improvements. The M109A1 is the basic vehicle used by artillery battalions in Europe and a special version known as the M992 Field Artillery Support Vehicle is now being introduced into service. The M992 is an ammunition carrier which is used to supply ammunition to M109s in the field. It carries the ammunition in racks, and from the racks rounds can be moved mechanically and under cover into the recipient M109.

The M109 is in service in large numbers (about 2,500) but already its successor is under consideration: specifications have been drawn up for a new 155-mm (6.1-in) howitzer system known as the Divisional Support Weapon System, or DSWS. The DSWS will have an automatic loader, a computer-based fire-control system, inertial navigation equipment, a very high power-to-weight ratio (a prolonged series of 'shoot and scoot' fire missions is anticipated) and a high rate of fire at ranges up to 30000 m (32,800 yds). While such a weapon would be ideal, costs will be astronomical, so steps are being taken to improve the basic M109's performance and prolong its operational life.

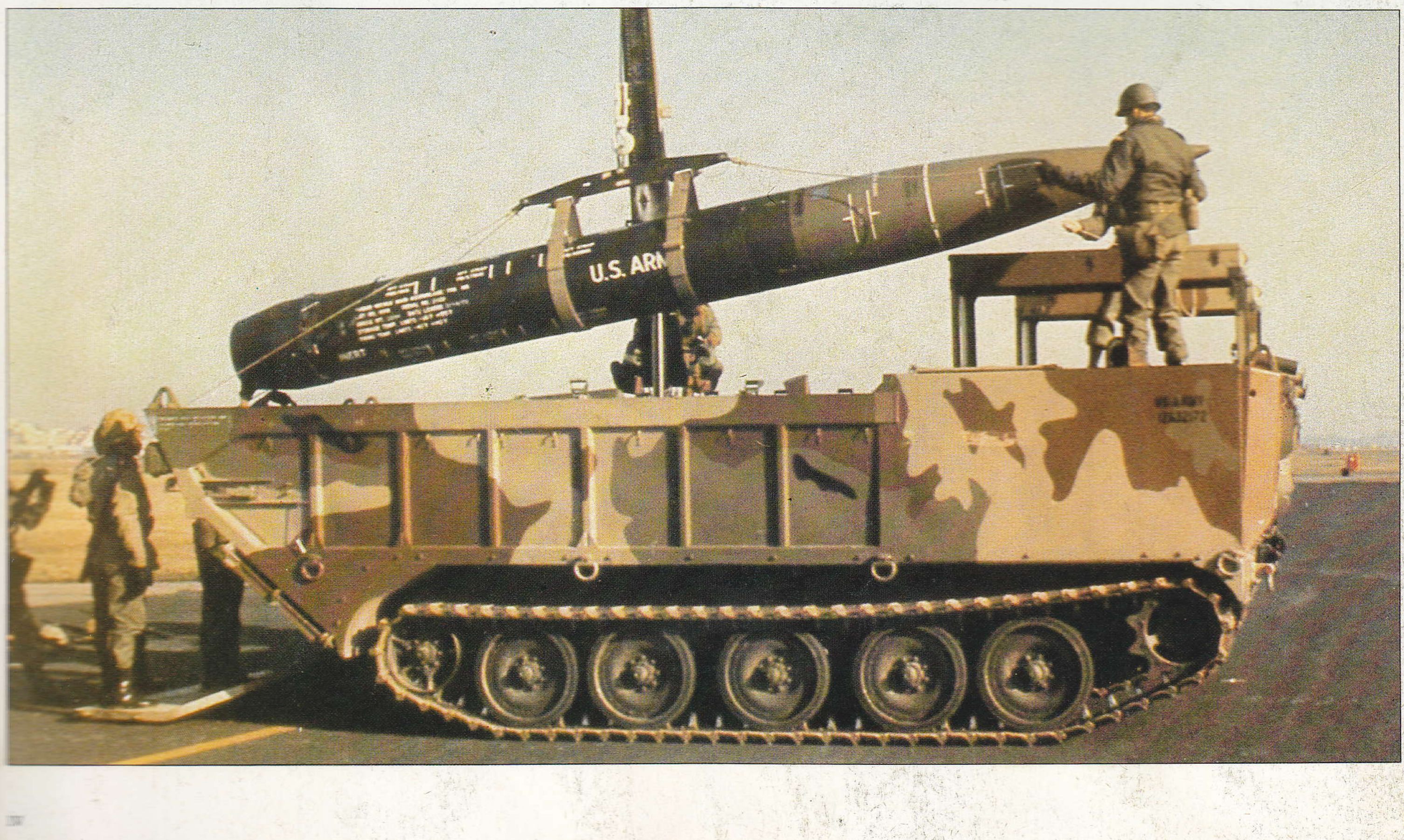
Towed artillery is still widely used in the US Army, with large numbers of M114 155-mm (6.1-in) towed howitzers still in service. The M114 is of World War II vintage, but with a new and longer barrel on a modified carriage has become the updated M114A2. The basic M114 fires a 43-kg (95-lb) HE shell to a range of 14600 m (15,975 yds).

A more modern 155-mm (6.1-in) howitzer is the M198, intended for use by the RDJTF and airborne artillery regiments. It is a thoroughly modern item with a long barrel and a light carriage. It fires the standard 43-kg (95-lb) shell to a range of 24000 m (26,250 yds). Like other 155-mm howitzers, the M198 can fire the laser-guided Copperhead projectile, intended for use against tanks, but development problems have delayed introduction of this munition, and it may be some time before Copperhead enters service. Meanwhile, a nuclear projectile for 155-mm howitzers is under development, as is a binary chemical-carrying projectile. Cargo rounds carrying explosive submunitions and small mines are already in the 155-mm inventory.

Numbers of towed 105-mm (4.13-in) howitzers are still used by some airborne artillery battalions. The model now used is the 105-mm M102, a weapon specifically tailored for airborne units and firing the time-honoured standard 105-mm (4.13-in) ammunition. The M102 can fire its HE shell to a range of 11500 m (12,575 yds). The M102 has a crew of from four to six, and can be towed or slung from a helicopter.



Since 1962 the 155-mm M109 has been the standard self-propelled howitzer of the US Army. The current production model is the M109A3, which has many improvements including a much longer barrel, increased ammunition capacity and the ability to fire new rounds a much greater distance.



A Lance surface-to-surface missile is carefully lowered on to its tracked launcher. Lance can be fitted with a variety of warheads, including tactical nuclear, and the missile is widely employed in NATO countries, including West Germany, Italy, Great Britain, Belgium and the Netherlands.